quarterly analysis review

17.1

1Q 2017

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snl	brandon heimer, becky levinson, nesty ray torres, todd west
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20 march 2016

topics

1 energy markets

automotive markets

technologies studies

environmental studies

consumers & opinion surveys

policy & business studies

qar

outline

1 energy markets

energy markets/production

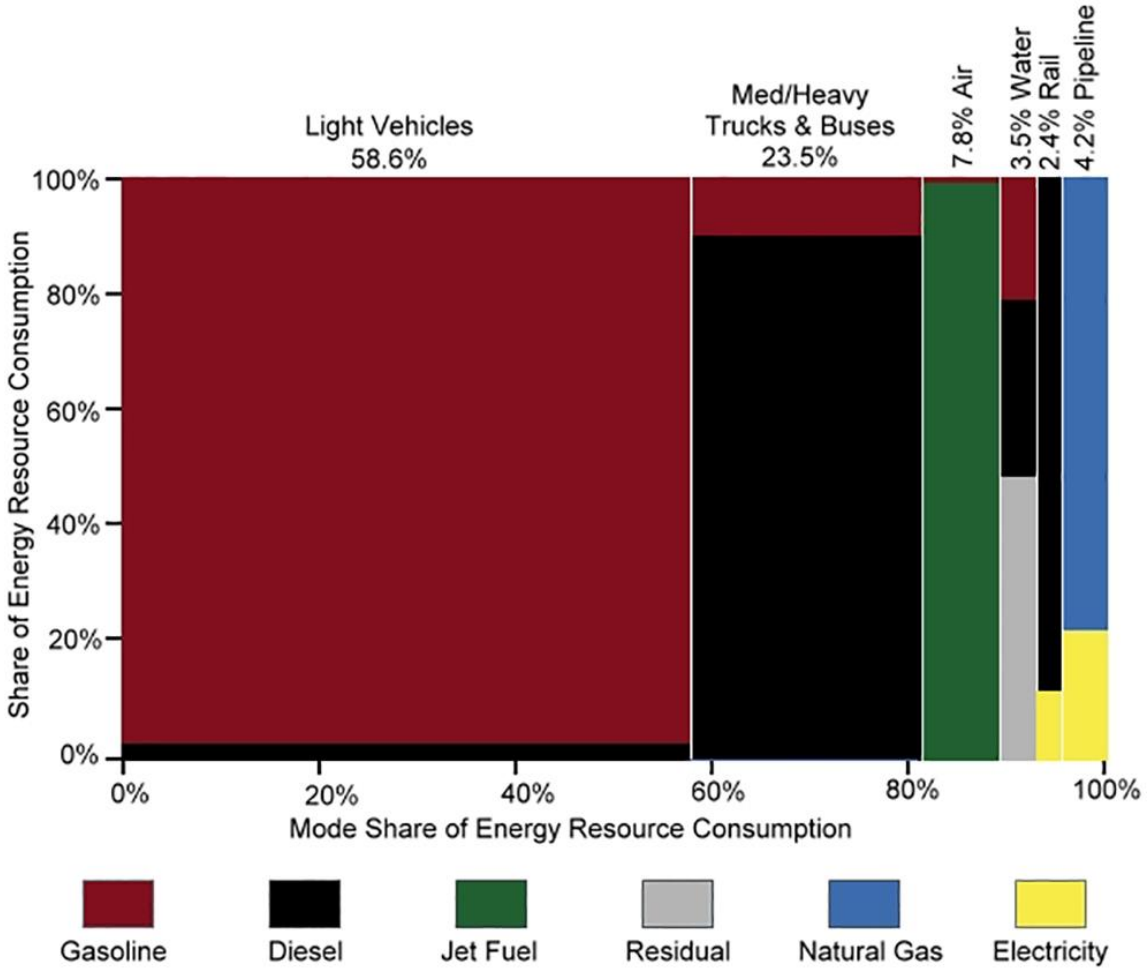
> EIA: U.S. transportation sector energy projected to peak in 2018
> FOTW: U.S. petroleum production down from 2015's peak
> FOTW: U.S. world's largest oil producer in 2015
> BP: Increased fuel economy will mostly offset increased demand for travel worldwide

vehicle fuels

> EIA: Gasoline prices remain near lowest levels in a decade, regional variation exists
> EIA: Ethanol production at all-time high
> FOTW: Electricity and CNG have least variable prices historically
> EIA: Natural gas for vehicles at all-time high

energy usage

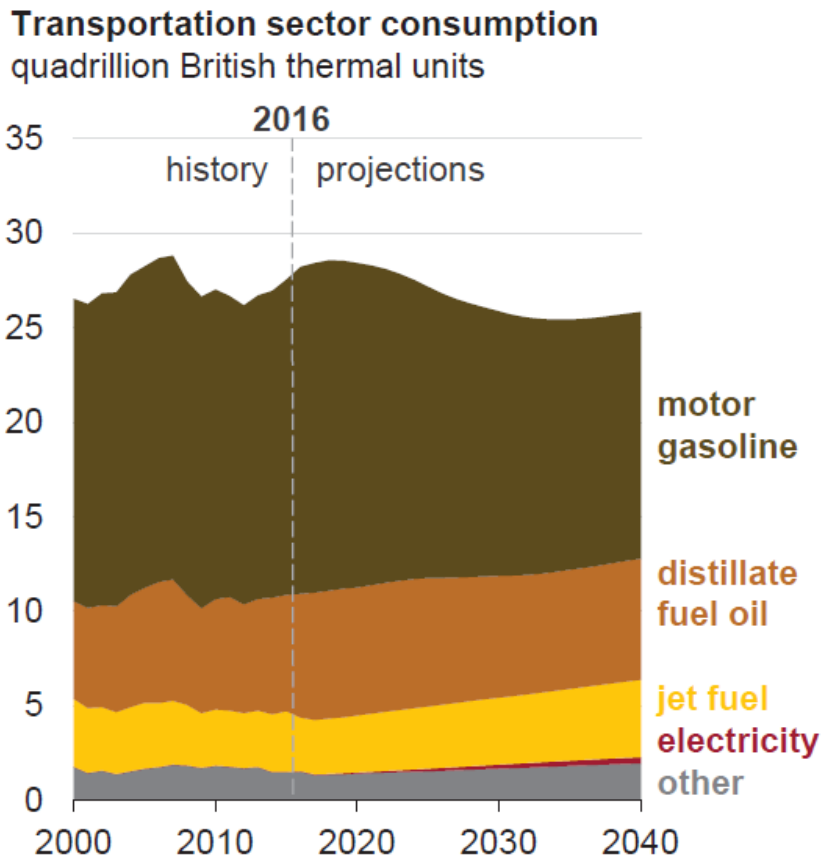
FOTW: On-road transportation consumes more than 80% of transportation energy in United States

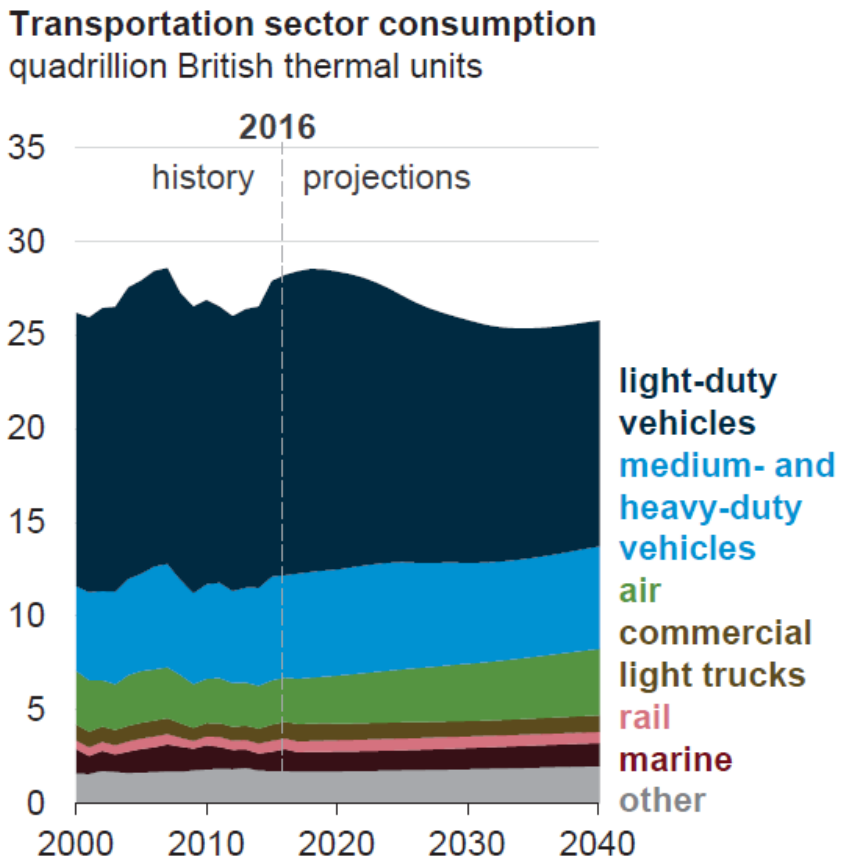


Source: http://energy.gov/eere/vehicles/fact-953-november-28-2016-road-transportation-consumes-more-80-all-transportation

energy usage

EIA: Domestic transportation sector energy consumption peaks in 2018; motor gasoline share drops as jet fuel grows (AEO 2017)

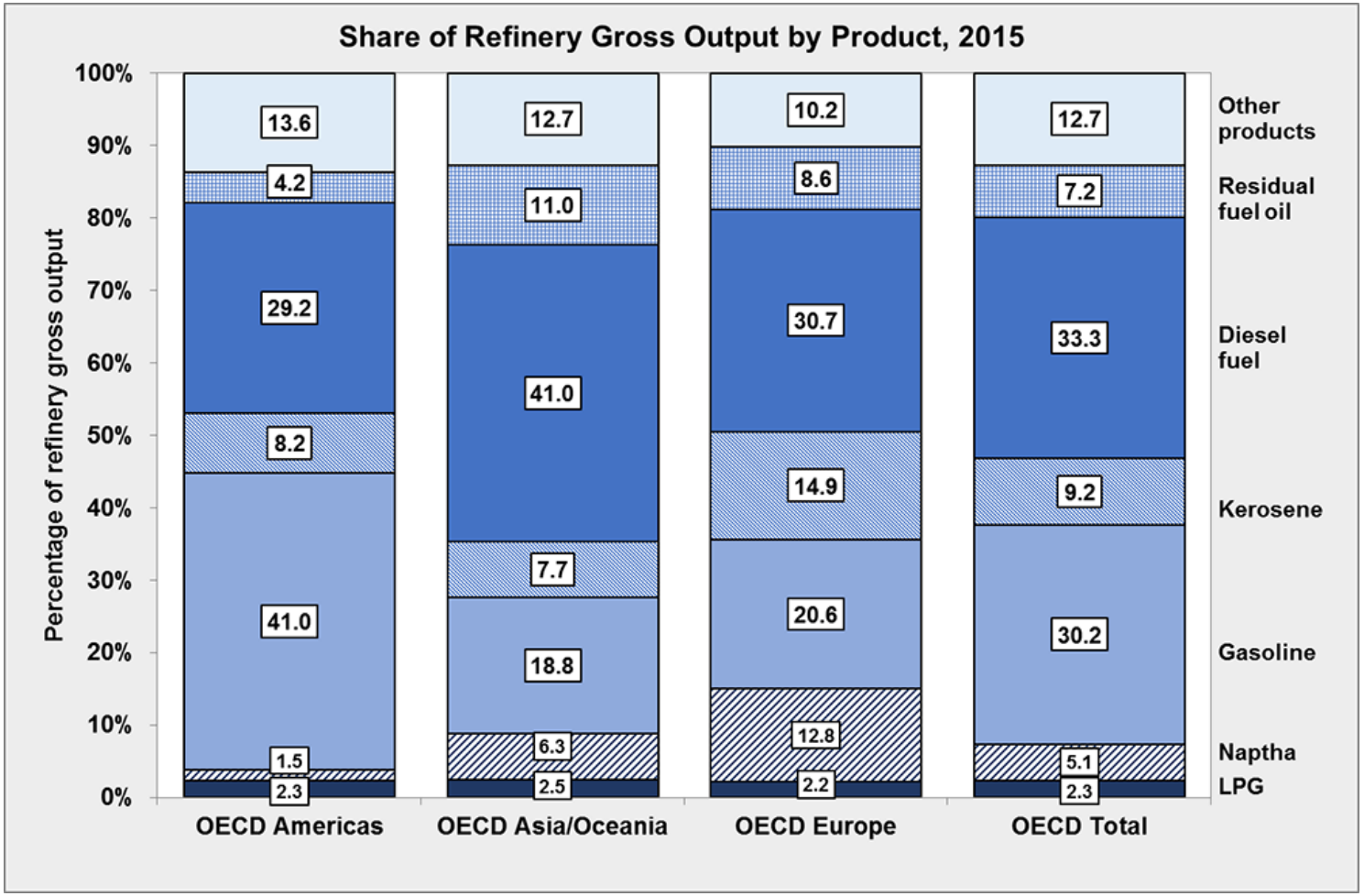




Source: https://www.eia.gov/outlooks/aeo/pdf/0383(2017).pdf

oil production

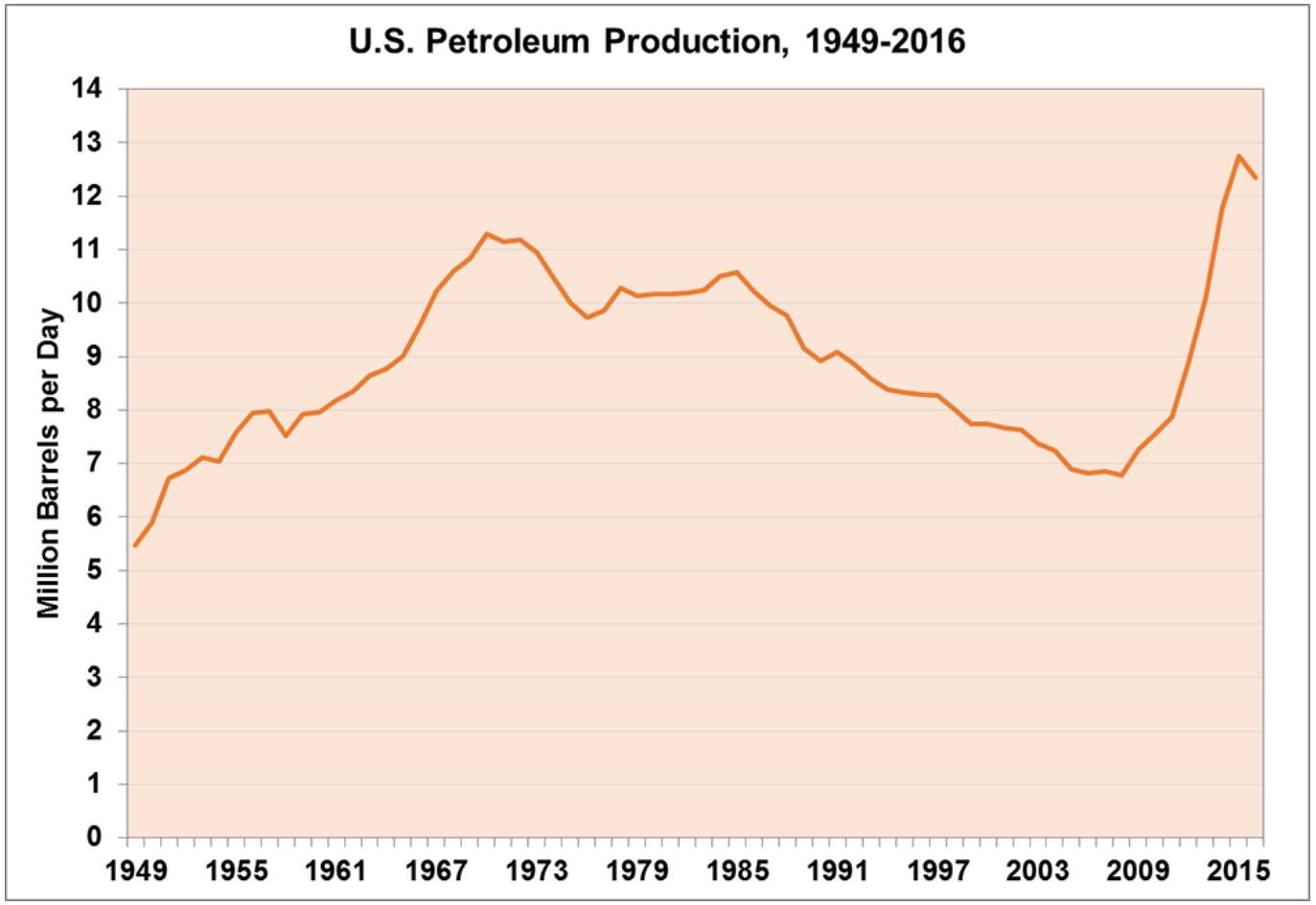
FOTW: Products of petroleum refineries vary by world region



Source: https://energy.gov/eere/vehicles/fact-963-february-6-2017-share-petroleum-product-output-refineries-varies-world-region

oil production

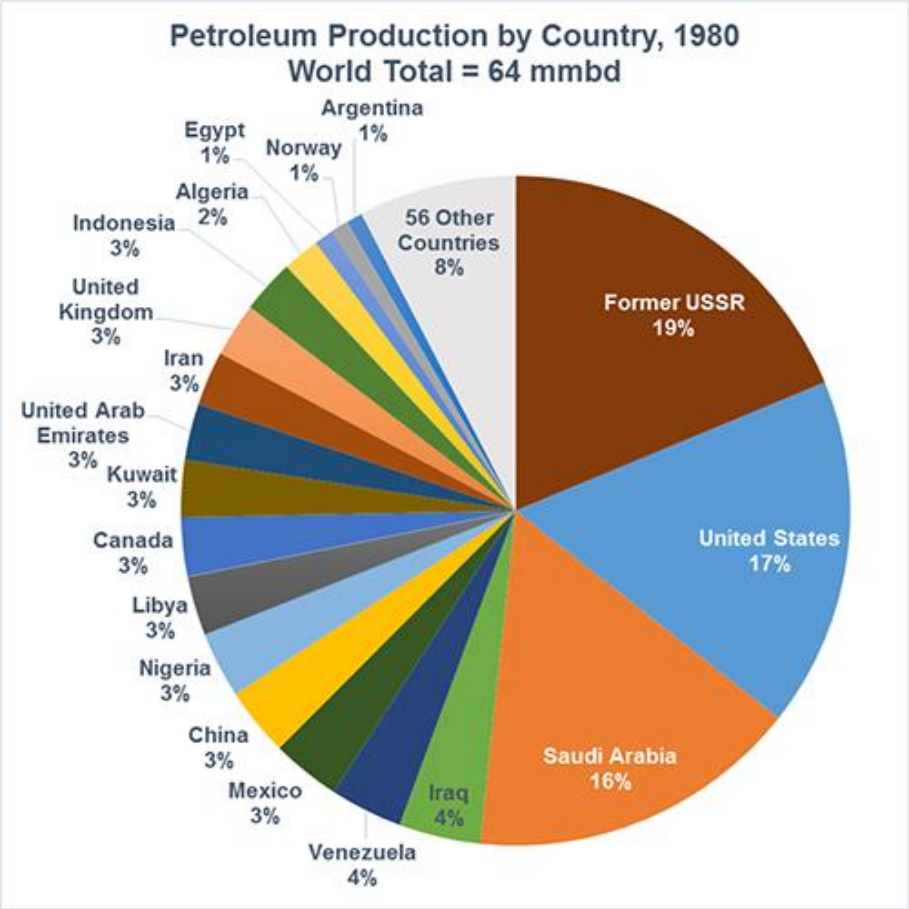
FOTW: Production of petroleum in the United States declined in 2016 from all-time high in 2015

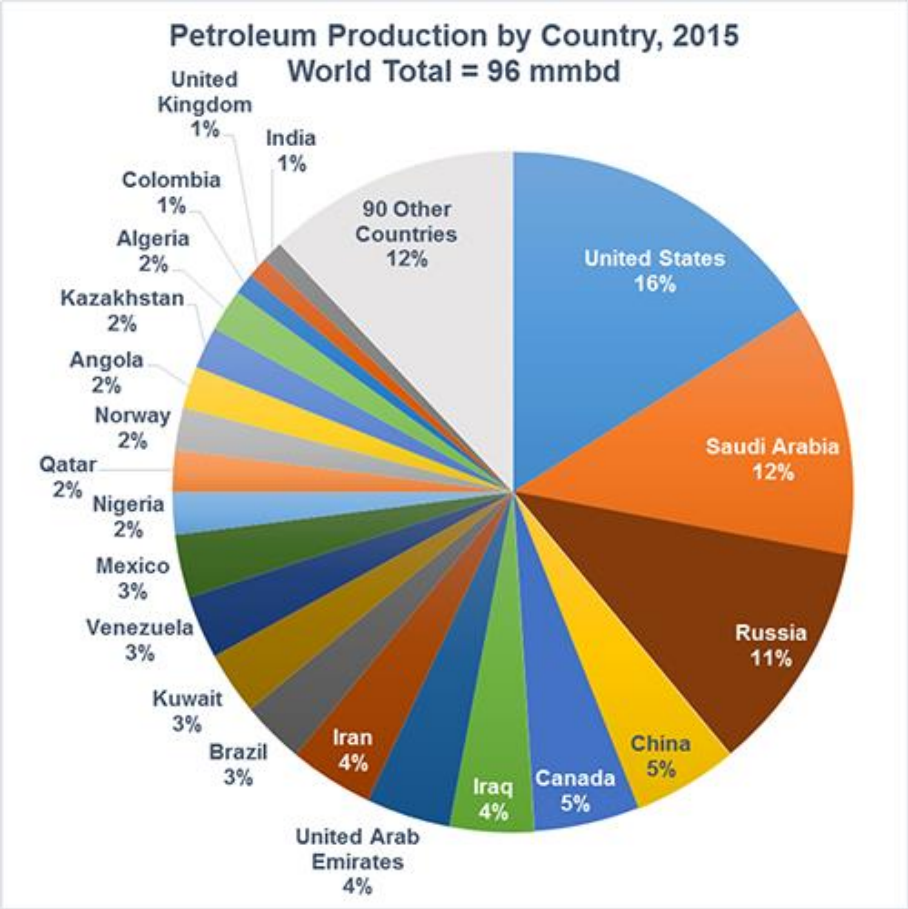


Source: https://energy.gov/eere/vehicles/fact-966-february-27-2017-production-petroleum-united-states-was-all-time-high-2015

oil production

FOTW: United States produced more petroleum than any other country in 2015

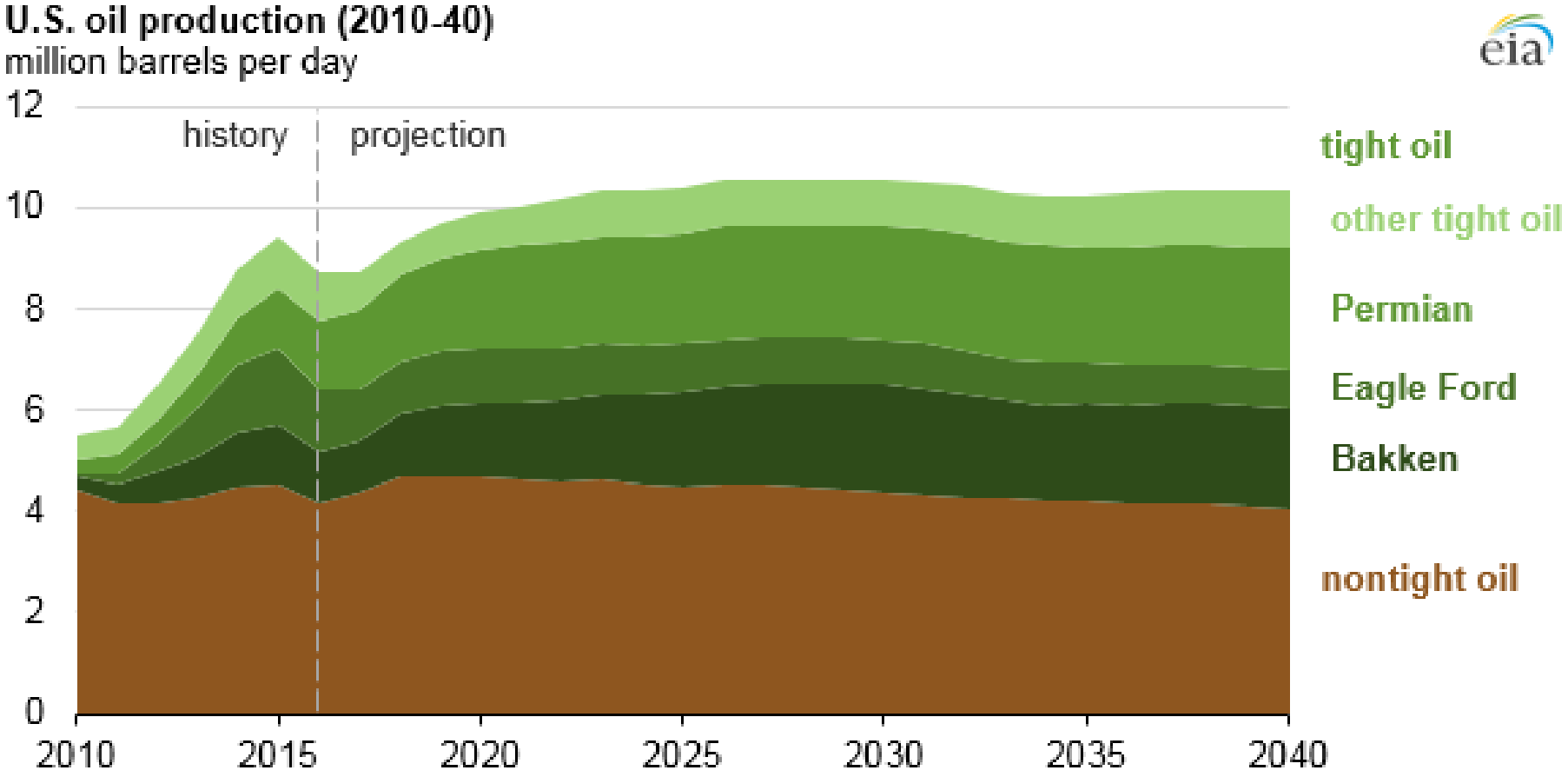




Source: https://energy.gov/eere/vehicles/fact-965-february-20-2017-united-states-produced-more-petroleum-any-other-country-2015

oil production

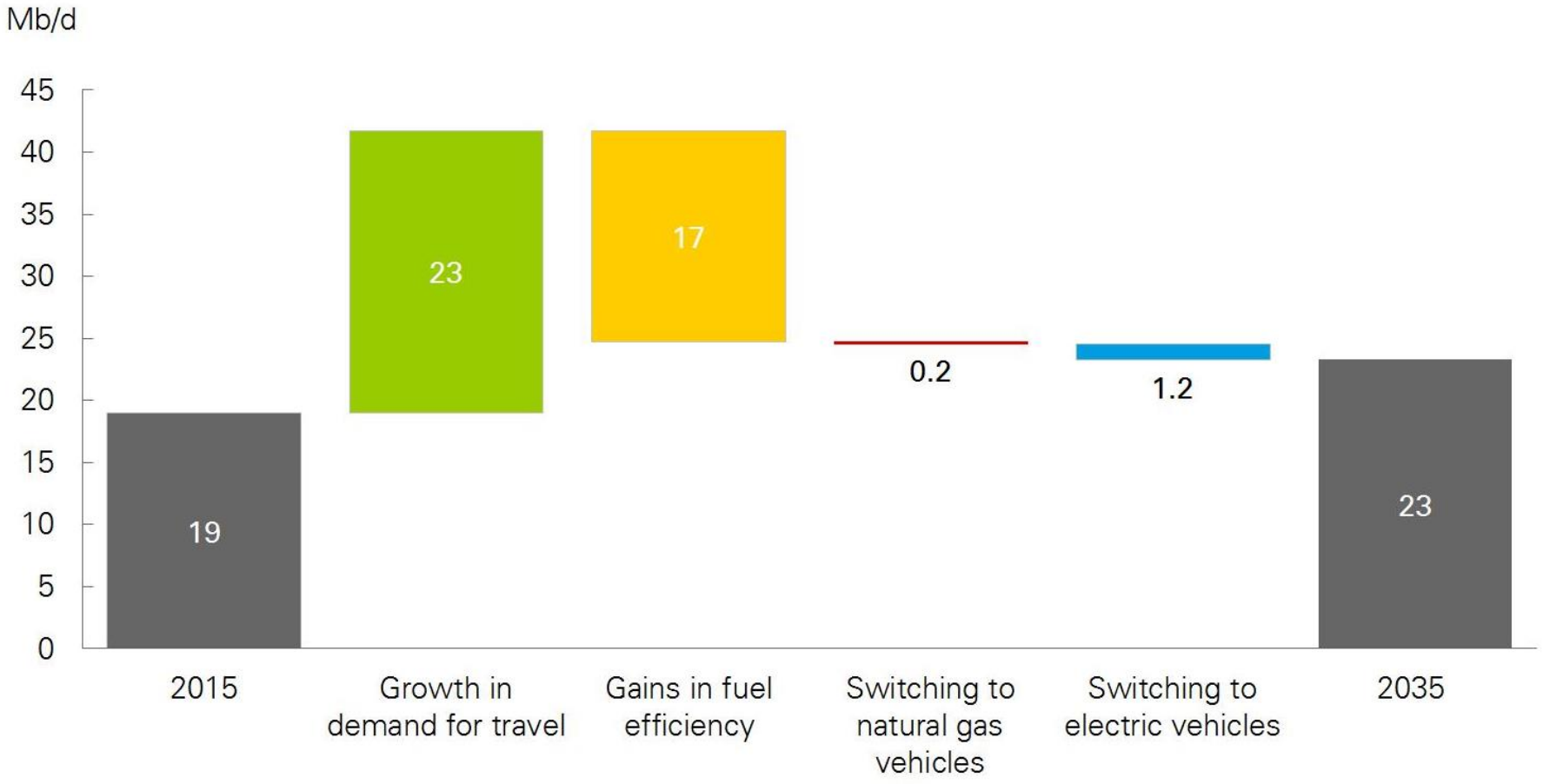
EIA: Tight oil expected to make up most of U.S. oil production increase through 2040



Source: https://www.eia.gov/todayinenergy/detail.php?id=29932

oil consumption

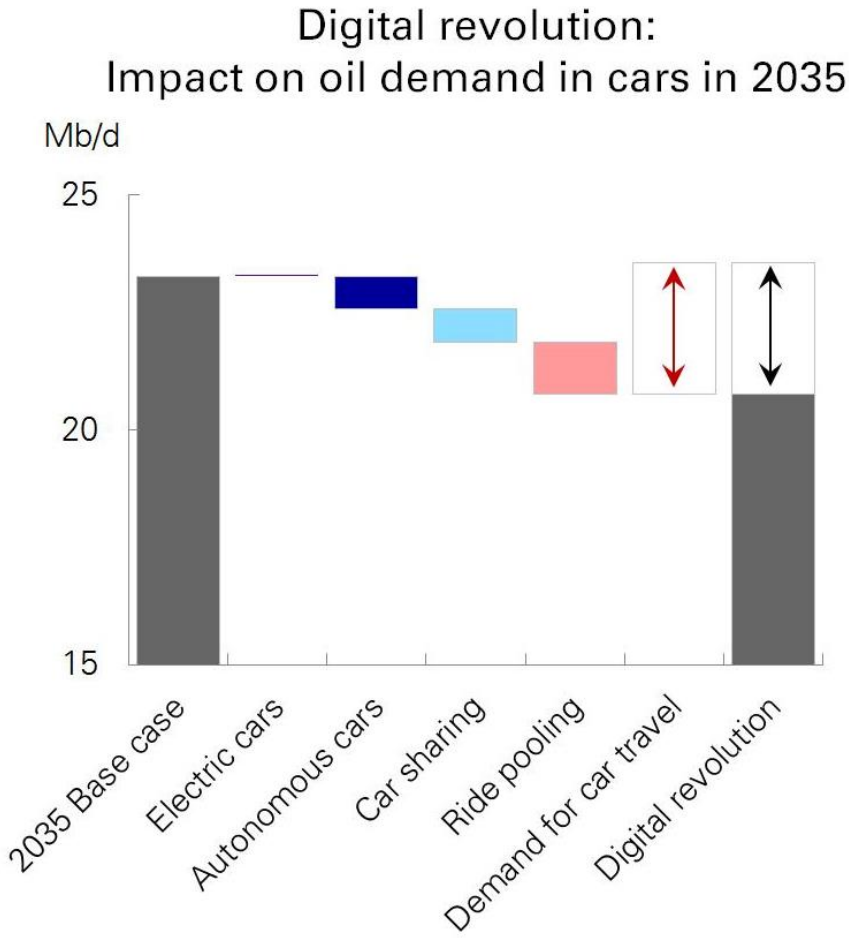
BP: Worldwide travel demand leads to increase in oil consumption; fuel efficiency mostly offsets increase

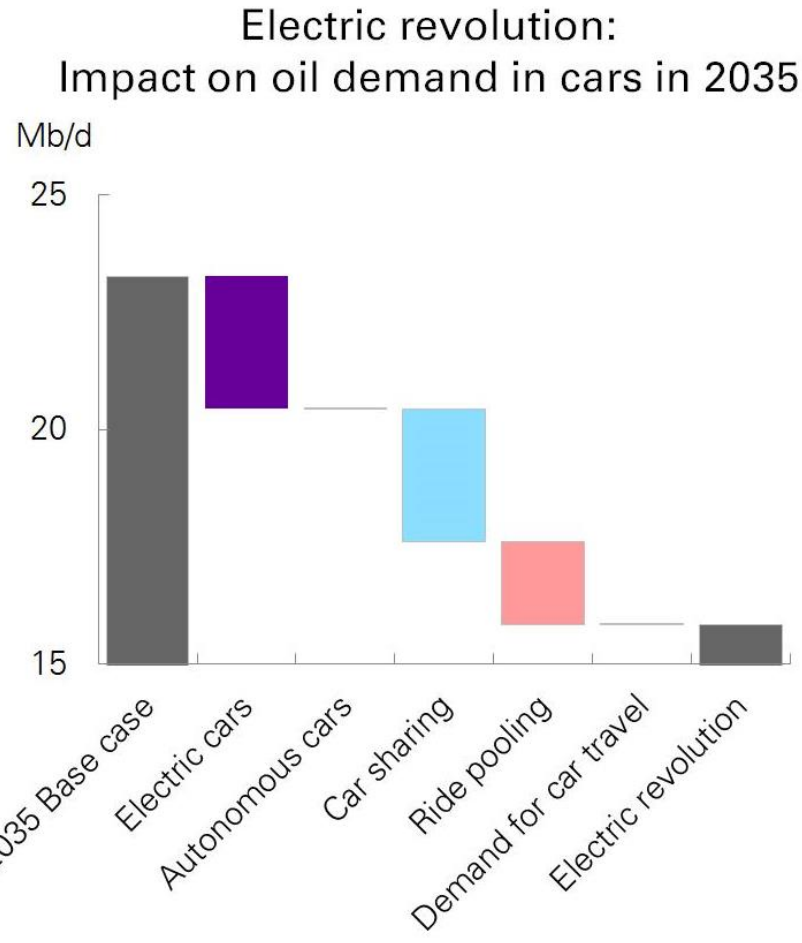


Source: http://www.bp.com/en/global/corporate/energy-economics/energy-outlook/energy-outlook-downloads.html

oil consumption

BP: Digital or electric revolutions could lower worldwide demand for oil

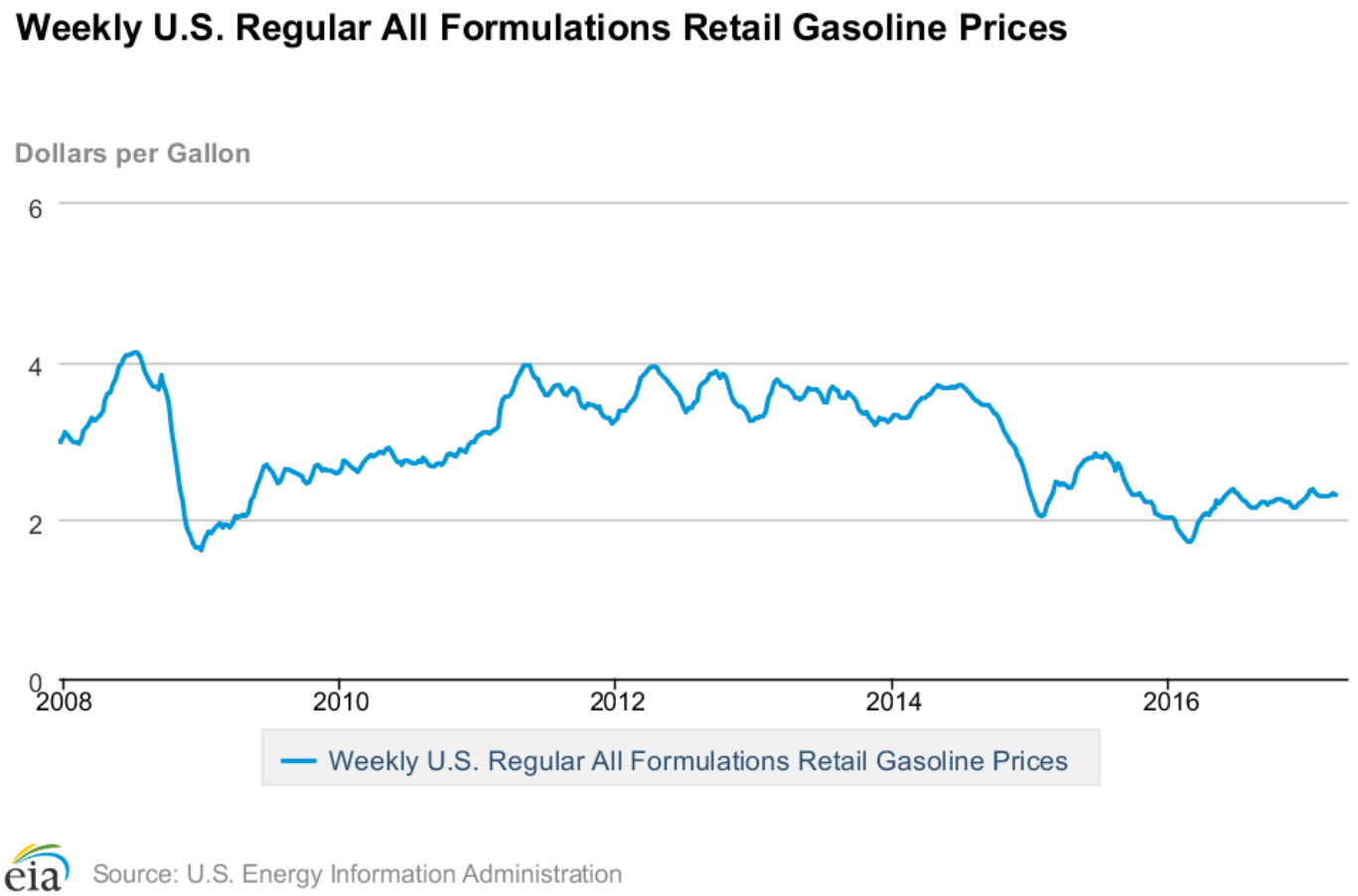




Source: http://www.bp.com/en/global/corporate/energy-economics/energy-outlook/energy-outlook-downloads.html

gasoline prices

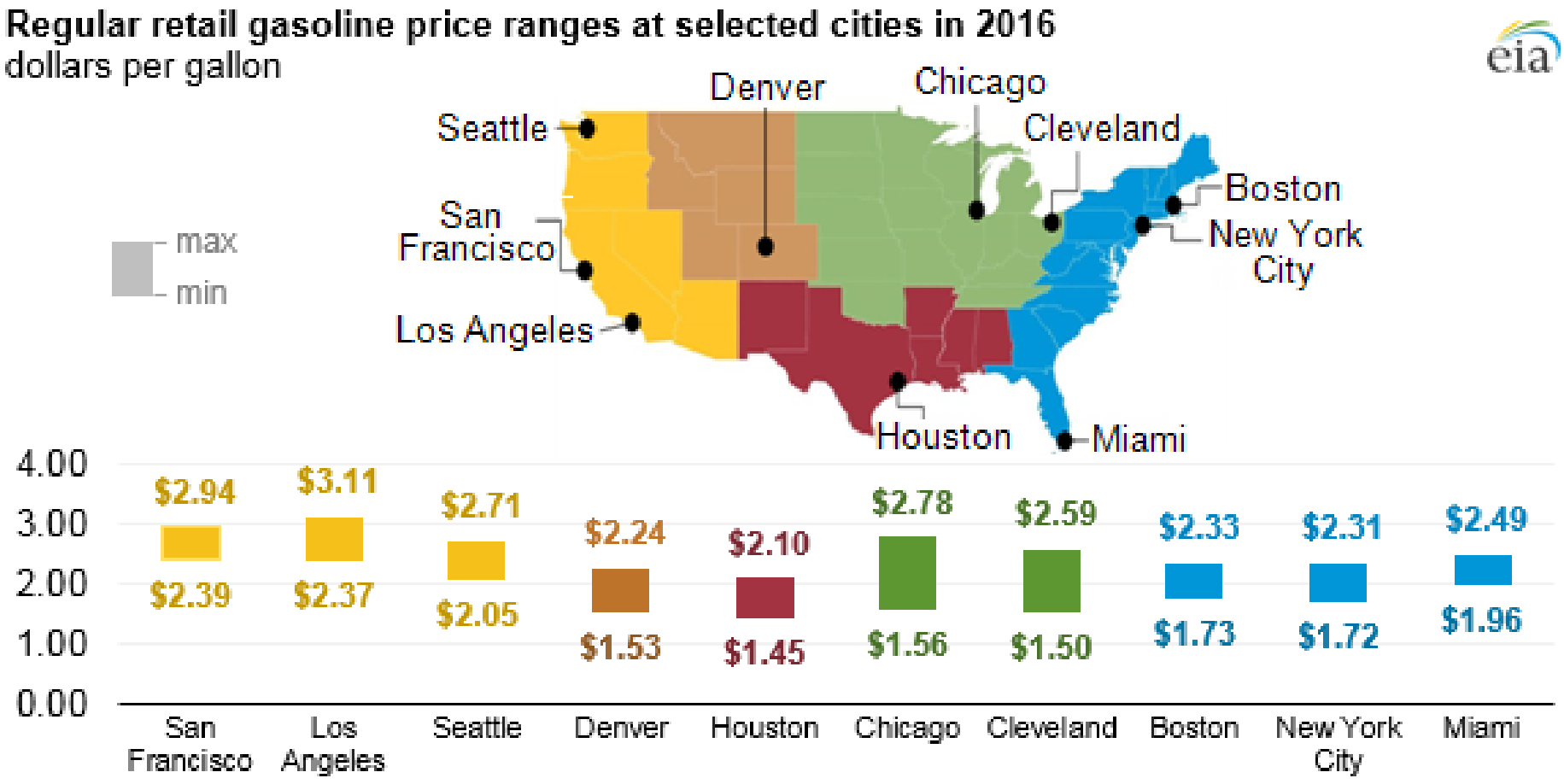
EIA: Gasoline prices higher than last year, still only half of price prices of a few years ago



Source: https://www.eia.gov/dnav/pet/pet_pri_gnd_dcus_nus_w.htm

gasoline prices

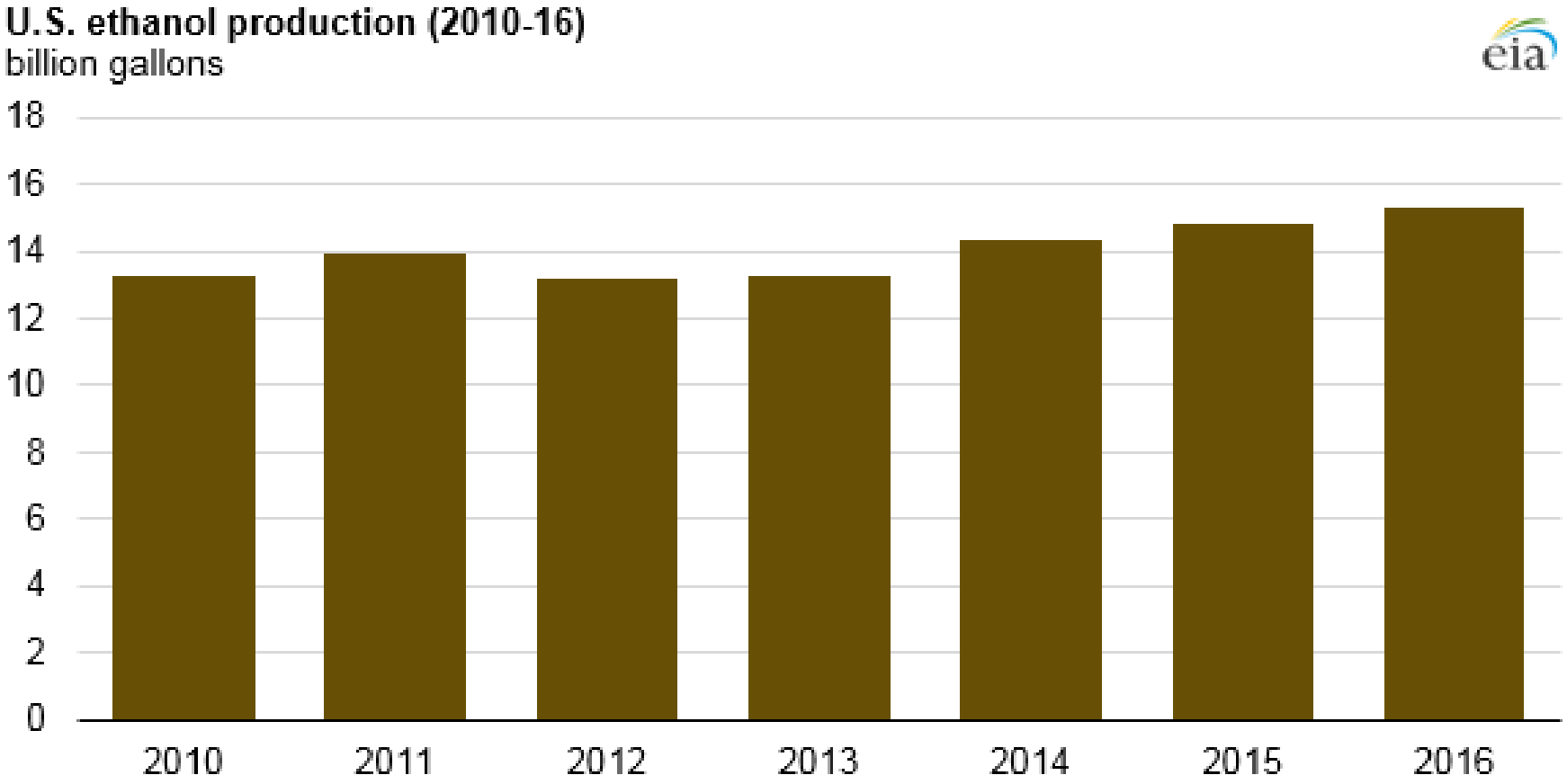
EIA: Highest gasoline prices on West Coast, lowest prices in South, largest price ranges in the Midwest



Source: https://www.eia.gov/todayinenergy/detail.php?id=29452

ethanol

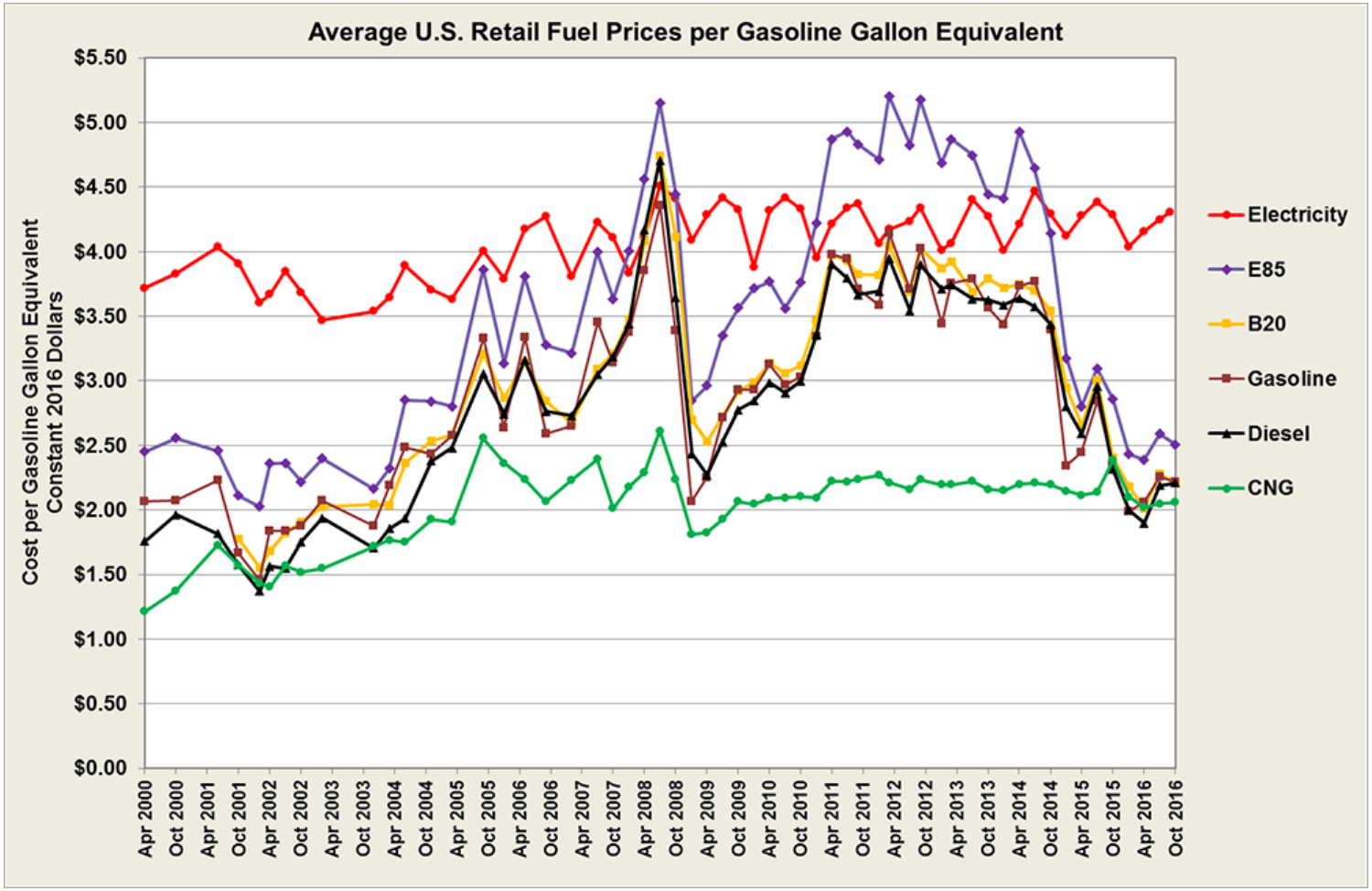
EIA: Record high production of ethanol in United States in 2016 – 15 billion gallons



Source: https://www.eia.gov/todayinenergy/detail.php?id=30372

fuel prices

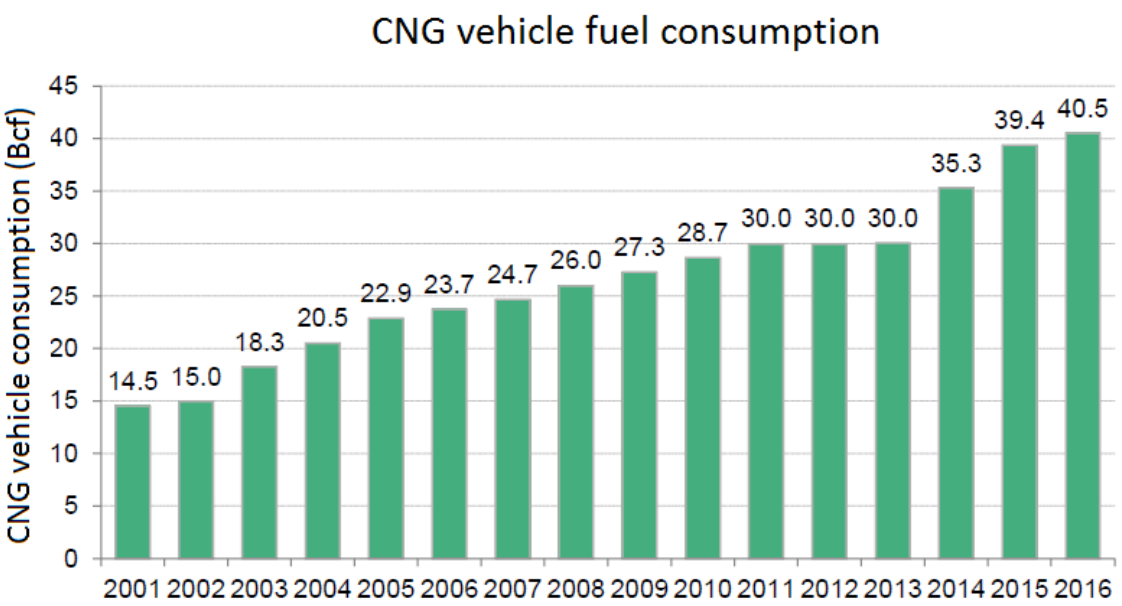
FOTW: Electricity and CNG fuels had the lowest price variability over the past 16 years

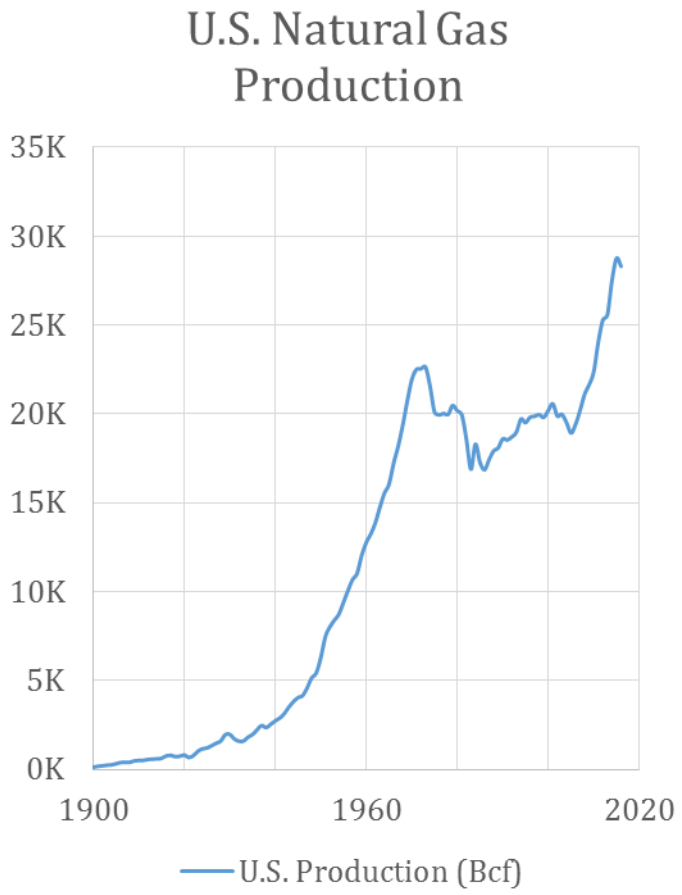


Source: https://energy.gov/eere/vehicles/fact-960-january-16-2017-electricity-and-cng-fuels-had-lowest-price-variability-over

natural gas vehicles

BNEF, EIA: Natural gas demand from vehicles at all-time high; 40 billion cubic feet for vehicles of 28,300 Bcf total U.S. production





Sources: http://www.bcse.org/sustainableenergyfactbook/ and https://www.eia.gov/dnav/ng/hist/n9050us2a.htm

topics

2

energy markets

automotive markets

technologies studies

environmental studies

consumers & opinion surveys

policy & business studies

qar

outline

2 automotive markets

LDV market

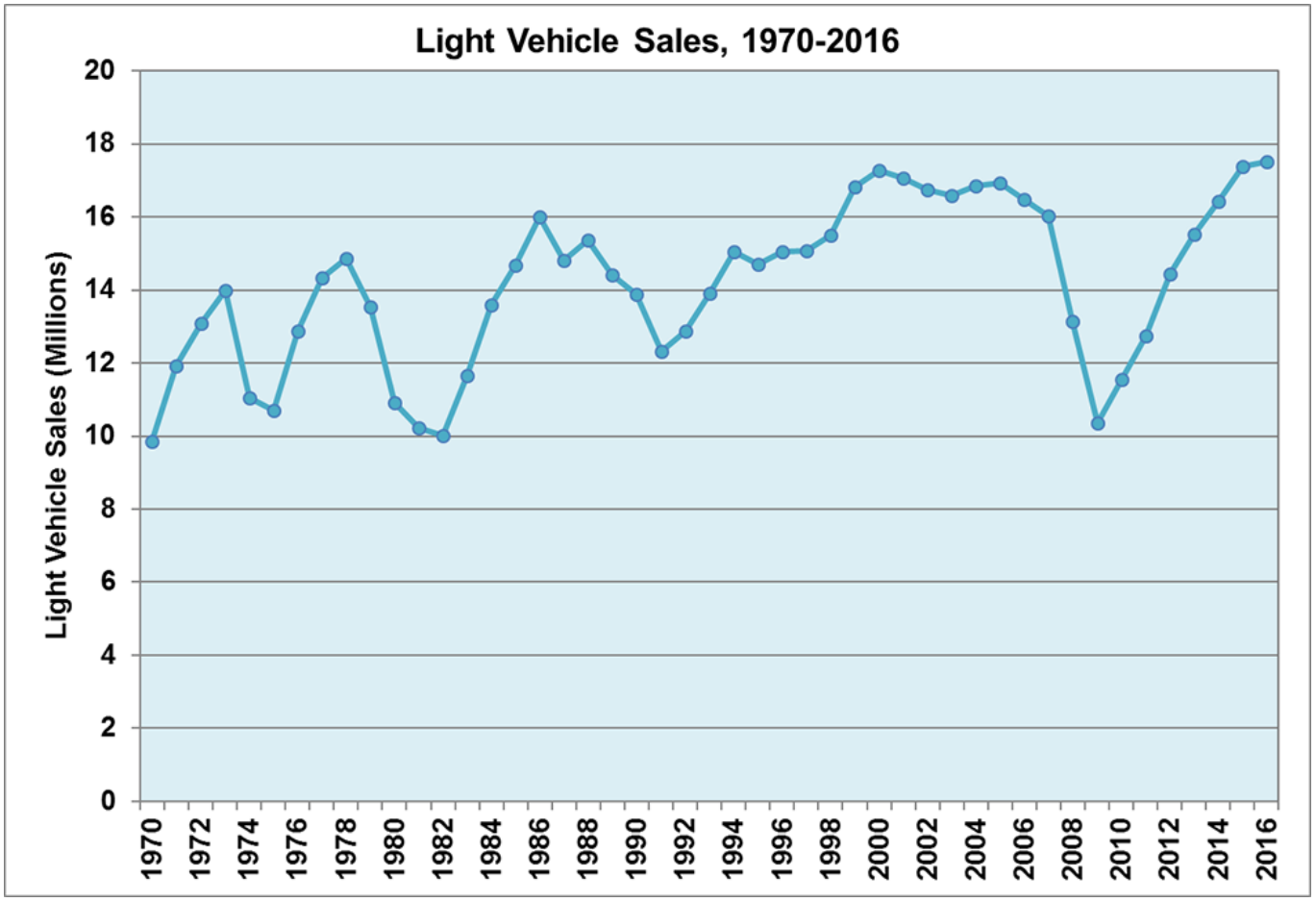
> FOTW: U.S. vehicle sales at all-time high again in 2016
> FOTW: Over 1/3 of LDVs sold in 2016 were SUVs

EV market

> EV-Volumes: China is largest market for EV
> EV-Volumes: Model S best-selling model, BYD best-selling manufacturer
> SAE: Chinese roadmap plans for large fractions of new-energy vehicles and autonomous vehicles

LDV market

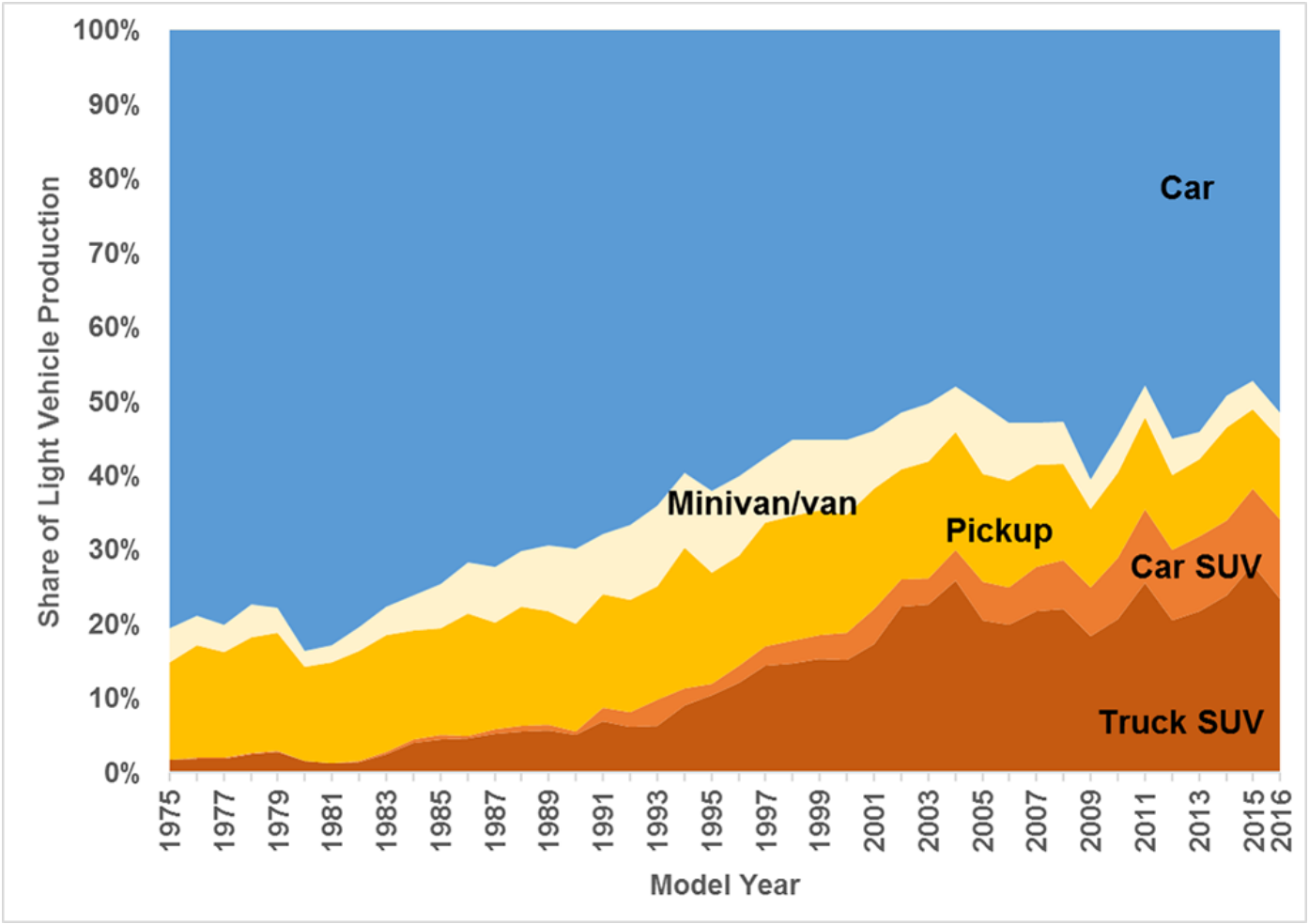
FOTW: Light-duty vehicle sales are at all-time high again in 2016; 7 consecutive years of sales increases



Source: https://energy.gov/eere/vehicles/fact-959-january-9-2017-record-light-vehicle-sales-2016

LDV market

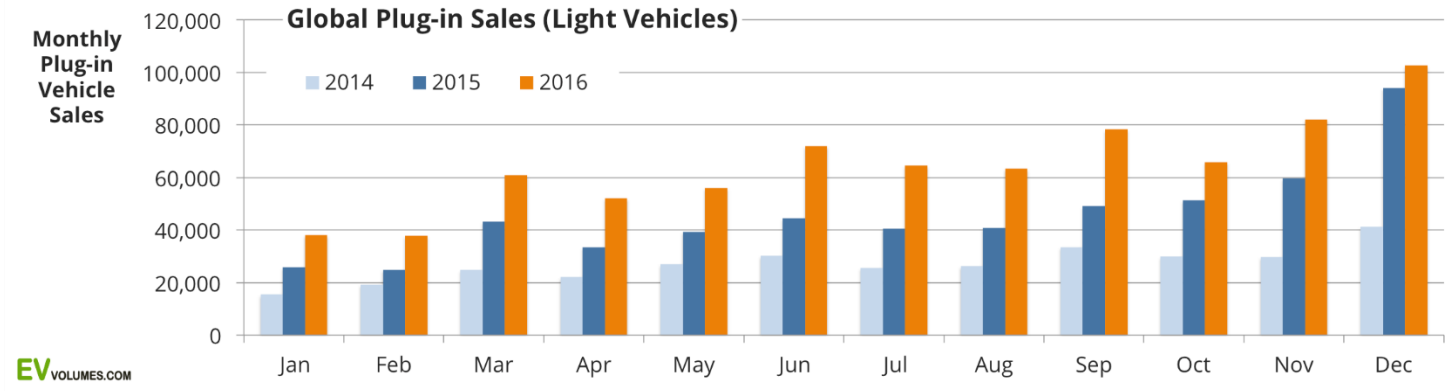
FOTW: Over one-third of light vehicles produced in MY2016 were SUVs

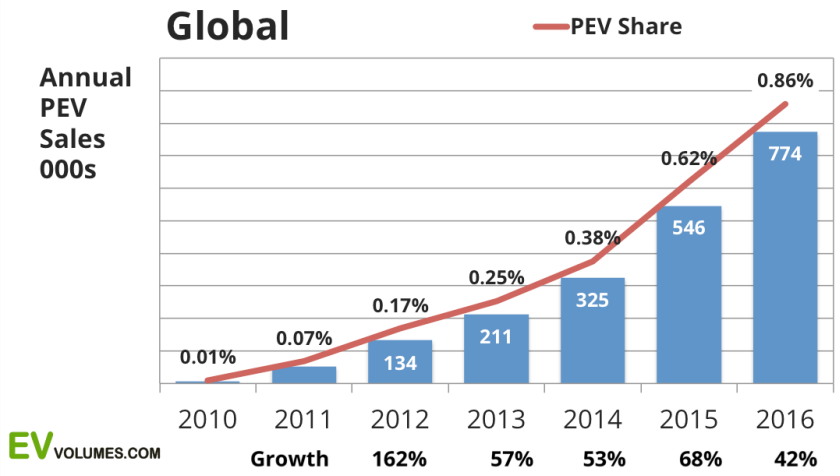


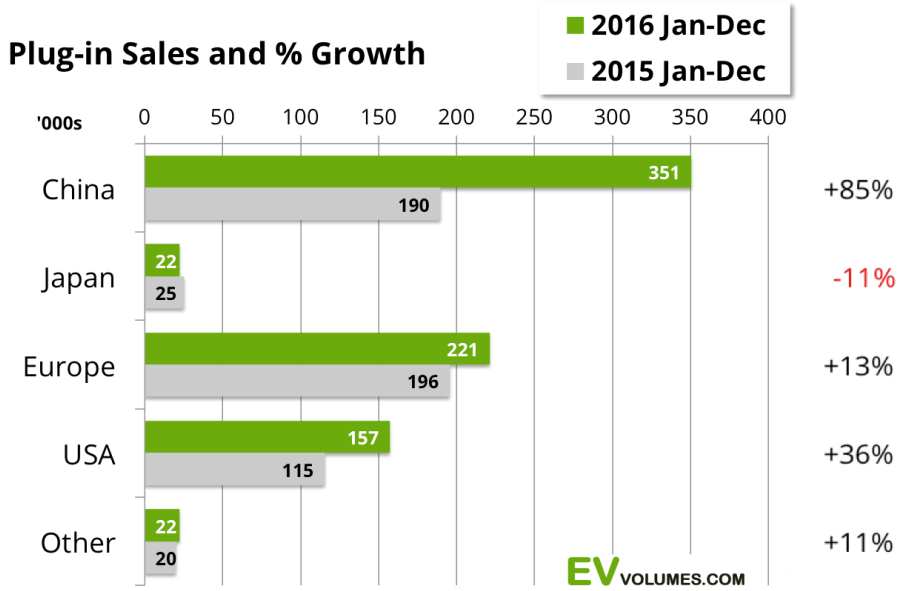
Source: https://energy.gov/eere/vehicles/fact-956-december-19-2016-thirty-four-percent-light-vehicles-produced-model-year-2016

EV market

EV-Volumes: EV sales continue to grow worldwide; China now world's largest market







Source: http://www.ev-volumes.com/news/global-plug-in-sales-for-2016/

EV market

EV-Volumes: Tesla Model S again top-selling EV model worldwide; BYD Tang top-selling PHEV and SUV

Tesla Model S: 50,935 (+2%)

Nissan Leaf: 49,818 (+7%)

BYD Tang PHEV SUV: 31,405 (+71%)

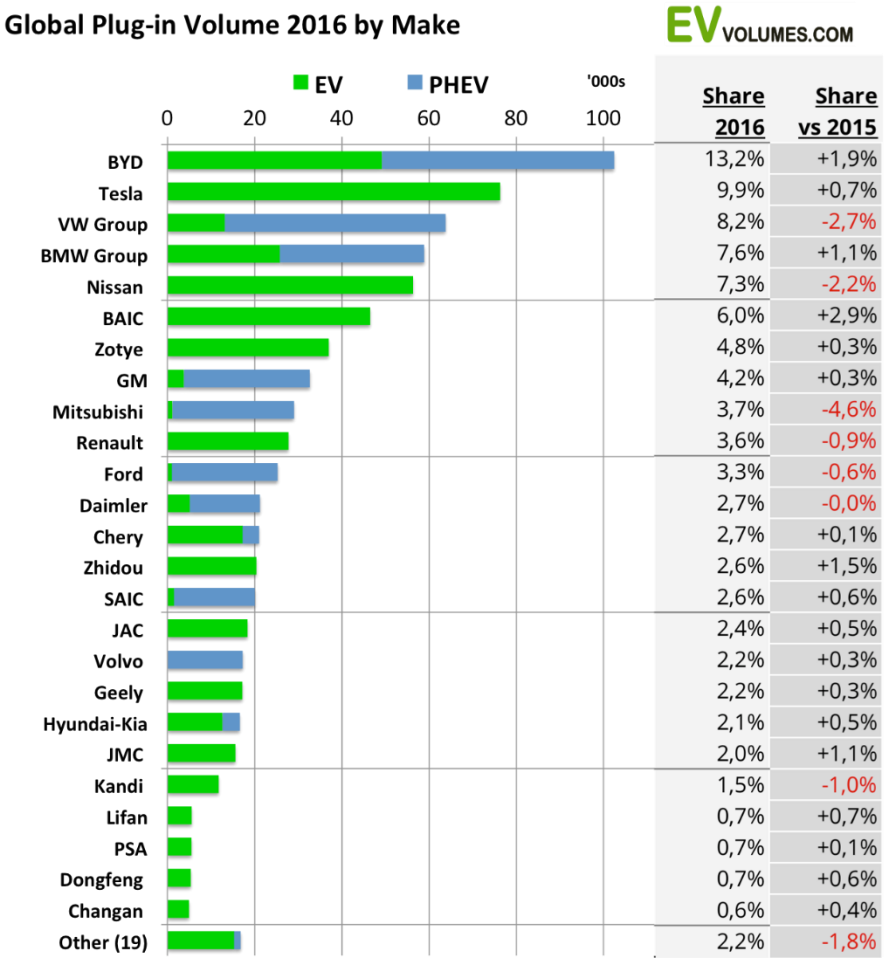
Chevrolet Volt: 28,295 (+67%)

Mitsubishi Outlander PHEV: 27,850 (-36%)

Source: http://www.ev-volumes.com/news/global-plug-in-sales-for-2016/

EV market

EV-Volumes: BYD top selling PEV manufacturer; worldwide market 61% BEV, 39% PHEV

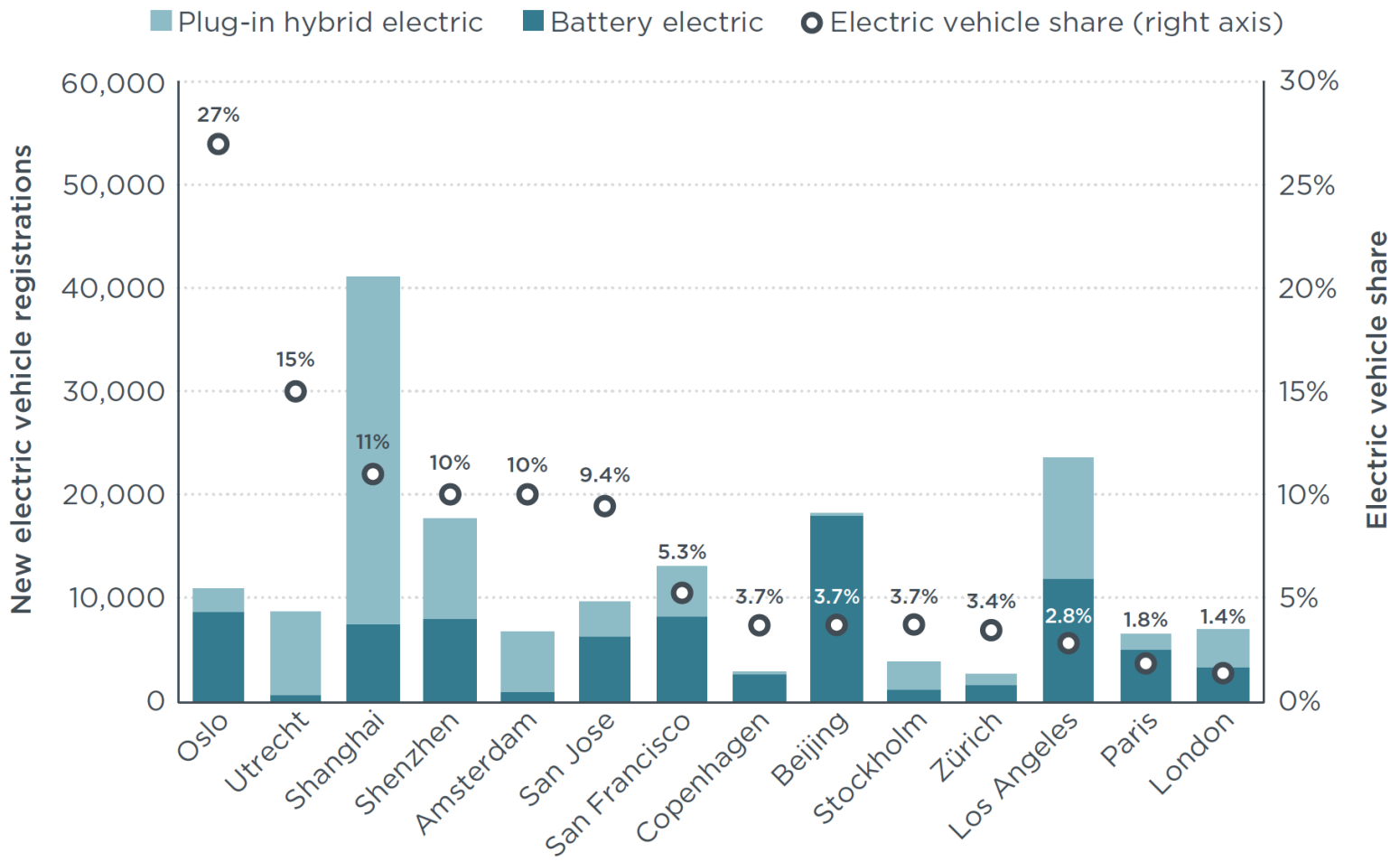


	Share 2016	Share vs 2015
BYD	13,2%	+1,9%
Tesla	9,9%	+0,7%
VW Group	8,2%	-2,7%
BMW Group	7,6%	+1,1%
Nissan	7,3%	-2,2%
BAIC	6,0%	+2,9%
Zotye	4,8%	+0,3%
GM	4,2%	+0,3%
Mitsubishi	3,7%	-4,6%
Renault	3,6%	-0,9%
Ford	3,3%	-0,6%
Daimler	2,7%	-0,0%
Chery	2,7%	+0,1%
Zhidou	2,6%	+1,5%
SAIC	2,6%	+0,6%
JAC	2,4%	+0,5%
Volvo	2,2%	+0,3%
Geely	2,2%	+0,3%
Hyundai-Kia	2,1%	+0,5%
JMC	2,0%	+1,1%
Kandi	1,5%	-1,0%
Lifan	0,7%	+0,7%
PSA	0,7%	+0,1%
Dongfeng	0,7%	+0,6%
Changan	0,6%	+0,4%
Other (19)	2,2%	-1,8%

Source: http://www.ev-volumes.com/news/global-plug-in-sales-for-2016/

EV market

ICCT: Shanghai has most PHEV sales in 2015; Beijing #1 for BEVs; Los Angeles #2 in each



Source: http://www.theicct.org/EV-capitals-of-the-world

LDV market

SAE China via MarkLines: Chinese "Technology Roadmap for Energy-Saving and New Energy Vehicles" projects large numbers of zero-emission vehicles and automated vehicles in near future

	2015 (performance)	2020	2025	2030
Chinese production and sales (units per year)	24.66 million (Sales)	30 million	30 million	30 million
Percentage of energy-saving vehicles	-	30%	40%	50%
Percentage of new energy vehicles	1.35%	7%-10%	15%-20%	40%-50%
Fuel cell vehicles (units)	-	5 thousand	50 thousand	1 million
Intelligent and connected cars (Installation rate in new vehicles of autonomous driving technology that has been introduced)	-	Driving assist and partial autonomous driving: 50%	High Automation: 10%-20%	Full Automation: 10%
(Source: Created based on SAE China's Technology Roadmap for Energy-Saving and New Energy Vehicles, various reports, and MarkLines data.)				

Sources: https://www.forbes.com/sites/michaeldunne/2016/12/14/chinas-automotive-2030-blueprint-no-1-globally-in-evs-autonomous-cars and http://www.jc-web.or.jp/jcbase/publics/download/?file=/files/content_type/type019/633/201612191644228232.pdf and https://www.marklines.com/en/report/rep1558_201612

topics

energy markets

automotive markets

3 technologies studies

environmental studies

consumers & opinion surveys

policy & business studies

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outline

3 technologies studies

fuel economy

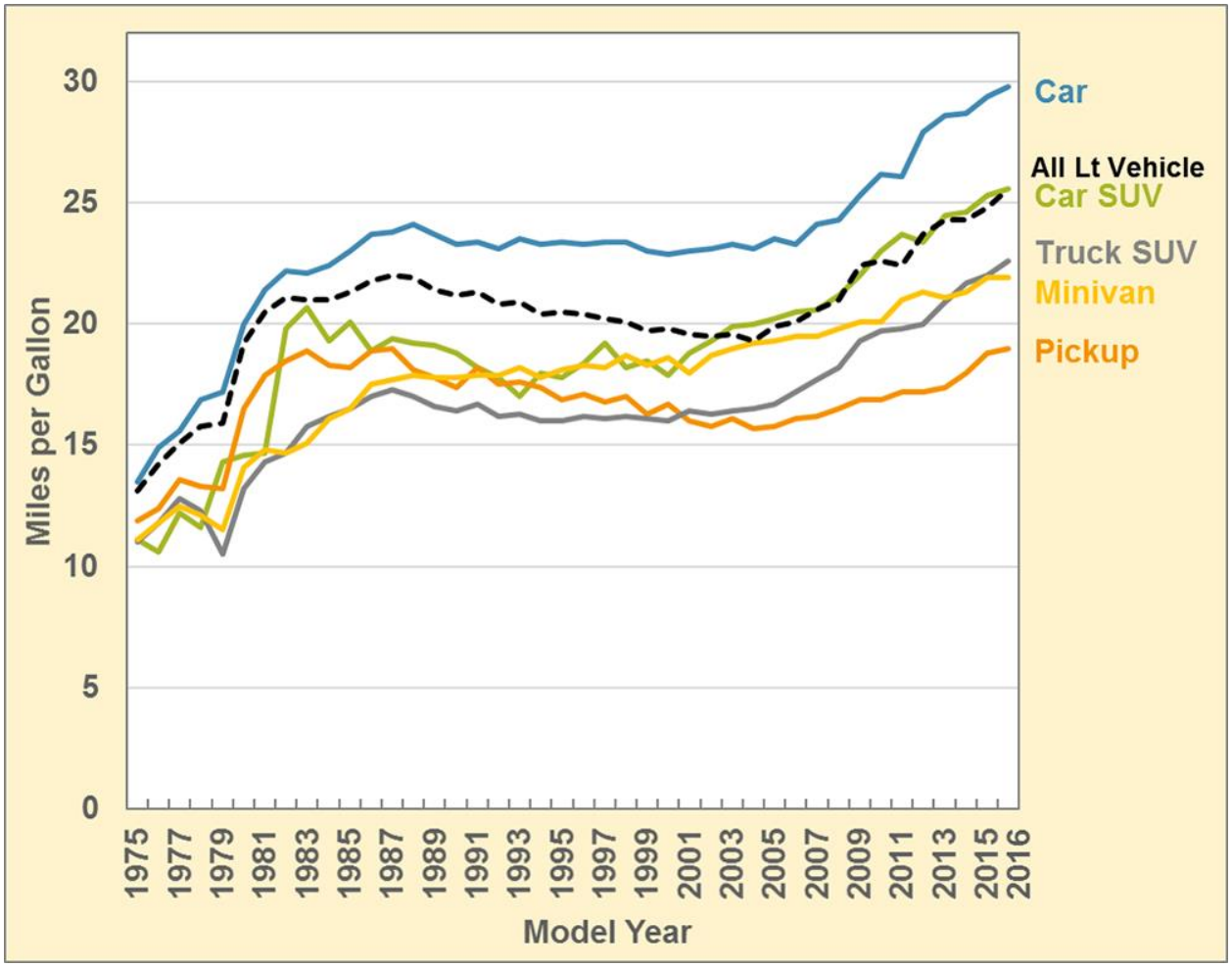
> FOTW: LDV fuel economy at all-time high in 2016
> EIA: Improved fuel economy for MDV and HDV projected to keep U.S. fuel consumption flat in future

vehicle technologies

> BNEF: Stop-start continues to grow in United States
> BNEF: Li-ion for autos will surpass Li-ion for batteries within 5 years
> IFI Claims: Number of patents growing for OEMs

fuel economy

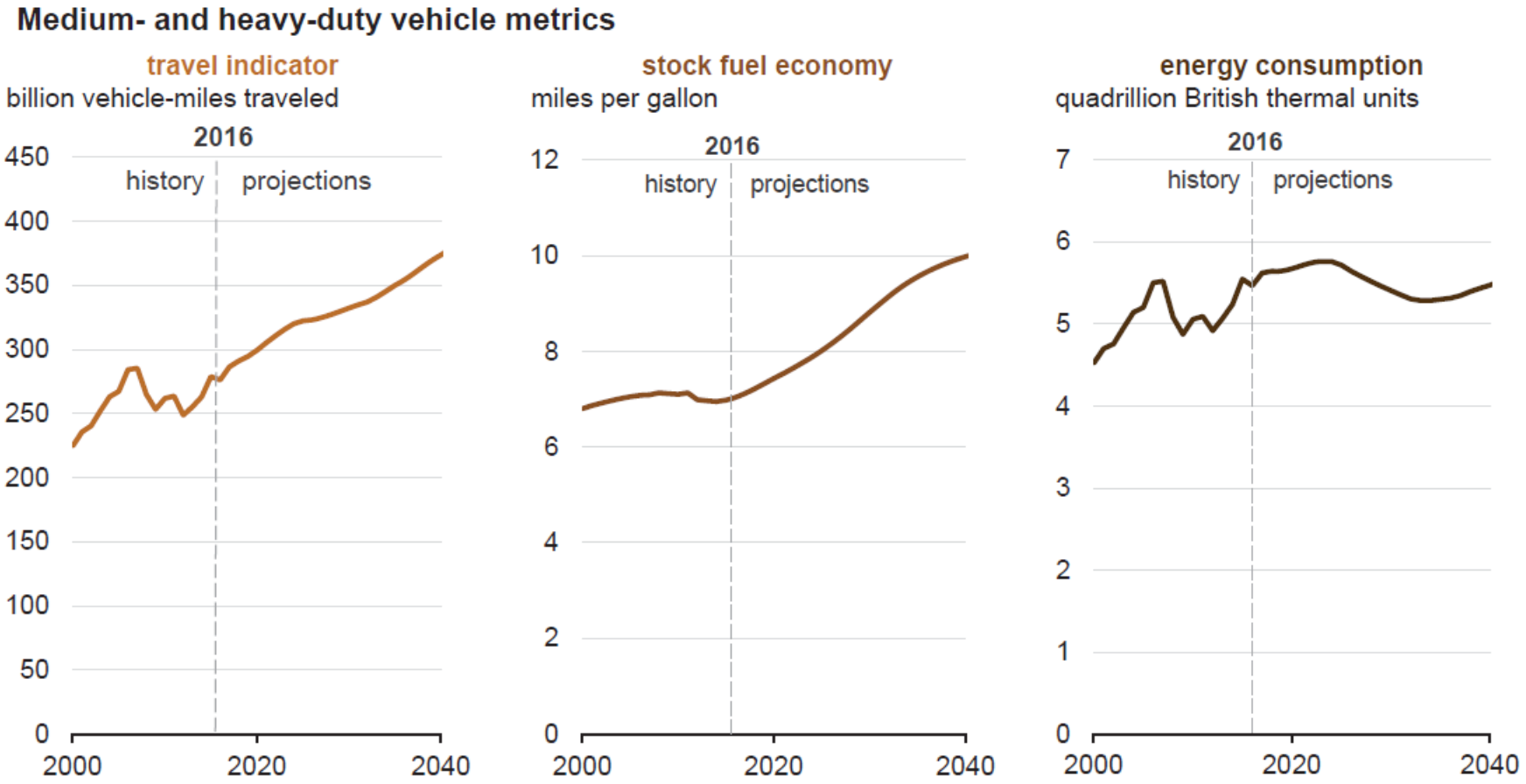
FOTW: New light vehicle fuel economy at all-time high in MY2016



Source: https://energy.gov/eere/vehicles/fact-955-december-12-2016-new-light-vehicle-fuel-economy-all-time-high

fuel economy

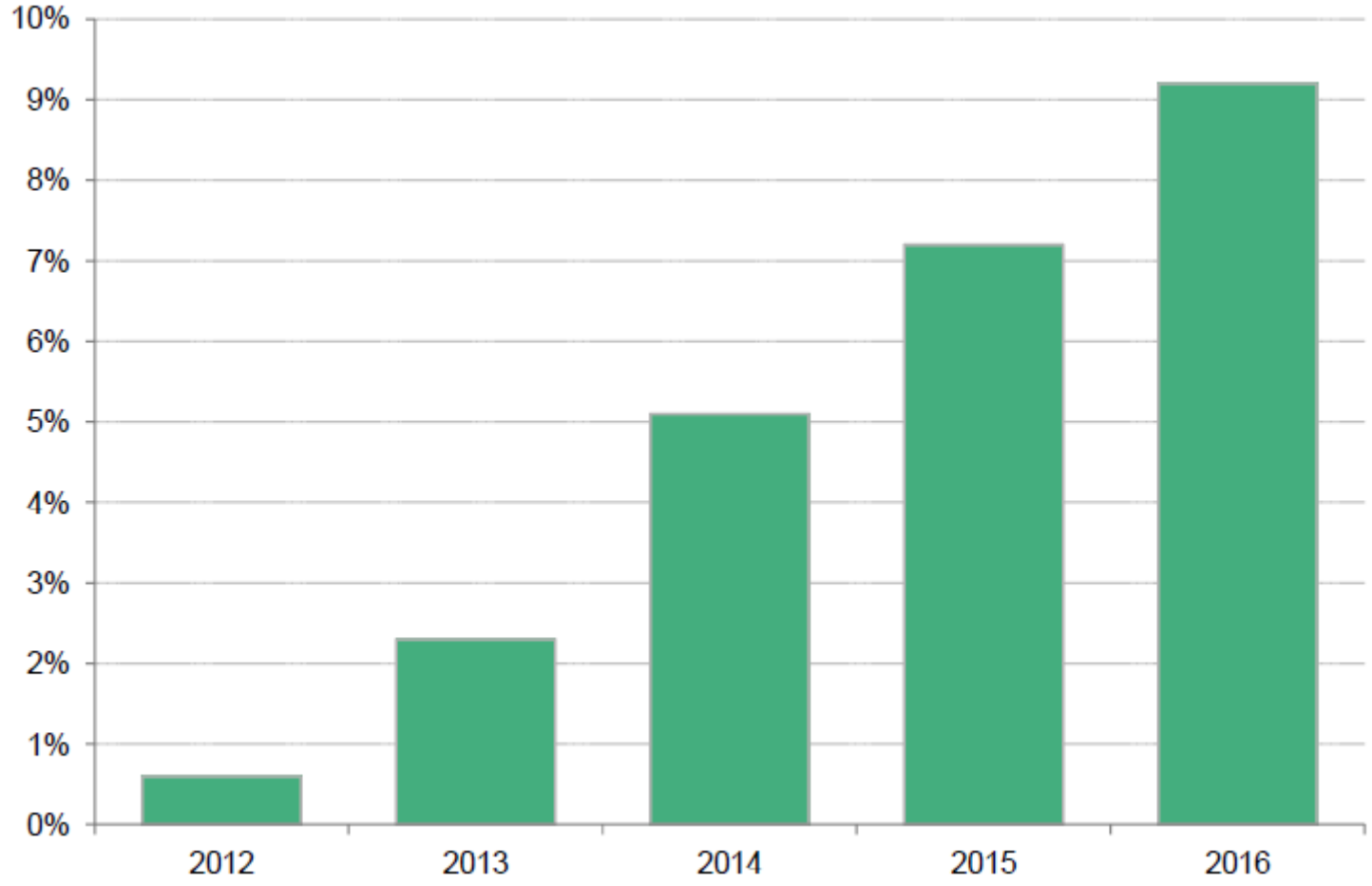
EIA: Fuel-economy improvements will keep MDV and HDV energy usage nearly flat through 2040 (AEO 2017)



Source: https://www.eia.gov/outlooks/aeo/pdf/0383(2017).pdf

vehicle technologies

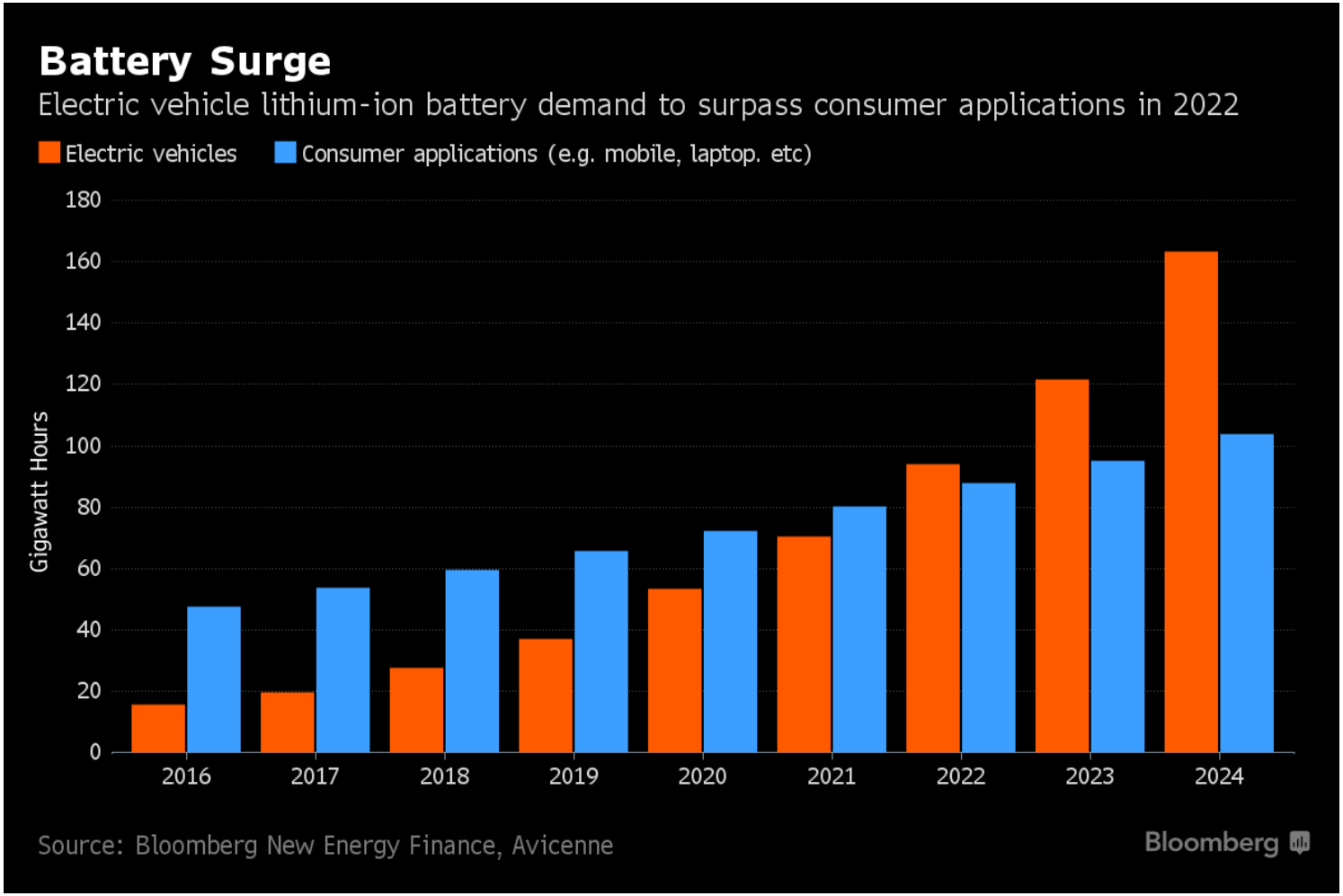
BNEF: Growing share of U.S. vehicles are being sold with start-stop technologies



Source: http://www.bcse.org/sustainableenergyfactbook/

vehicle technologies

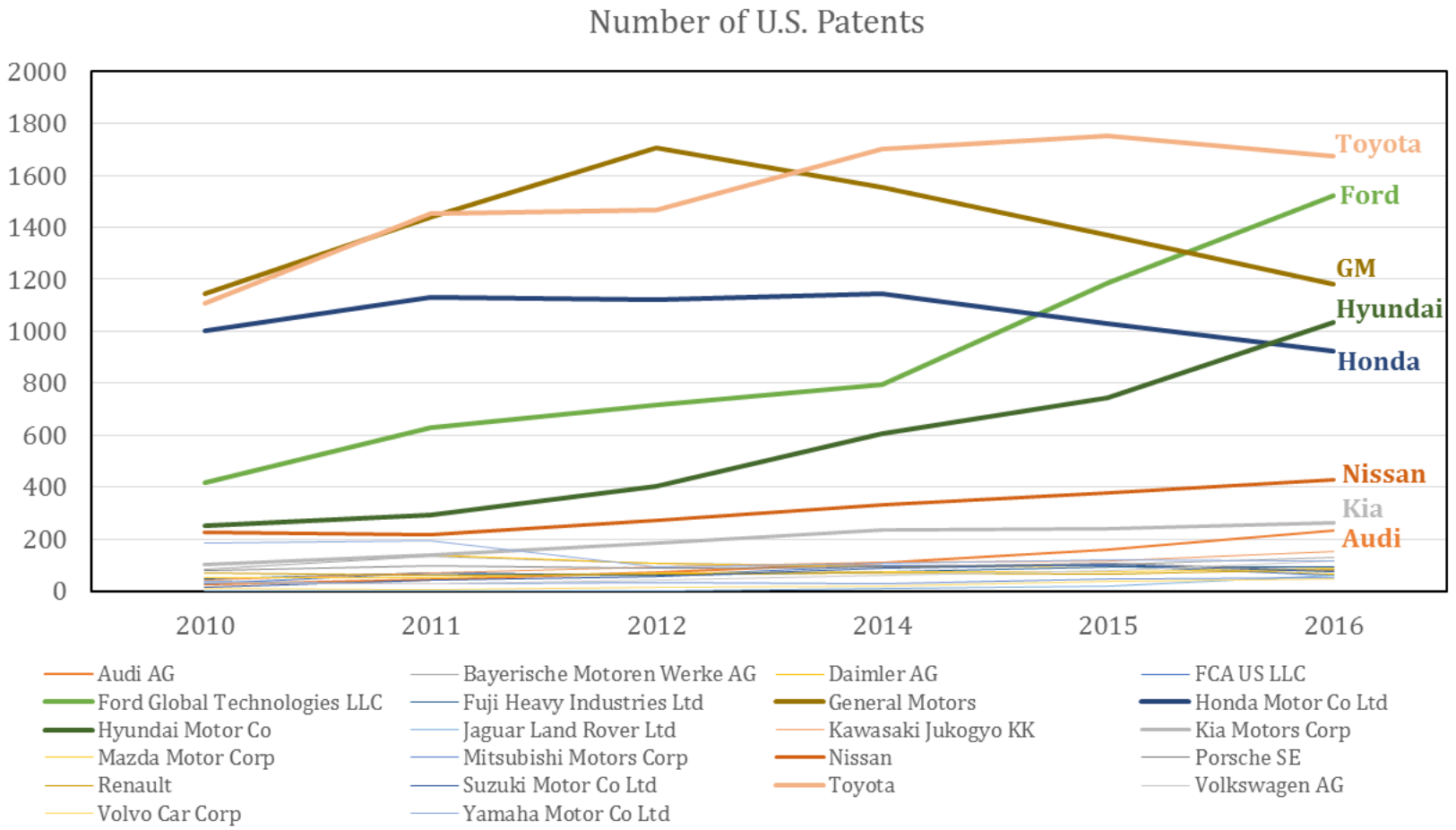
BNEF: Li-ion battery demand for EVs will surpass electronics by 2022



Source: https://www.bloomberg.com/news/articles/2017-03-14/google-ceo-schmidt-flags-promise-of-new-goodenough-battery

intellectual property

IFI Claims: OEM U.S. patents up nearly 70% since 2010; Ford and Hyundai largest gainers in 2016



Sources: http://www.ificlaims.com/index.php?page=rankings_top_US_assignees and http://www.ificlaims.com/index.php?page=news&type=view&id=ifi-claims%2F2016-u-s-patent-trends_4

topics

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4 environmental studies

emissions

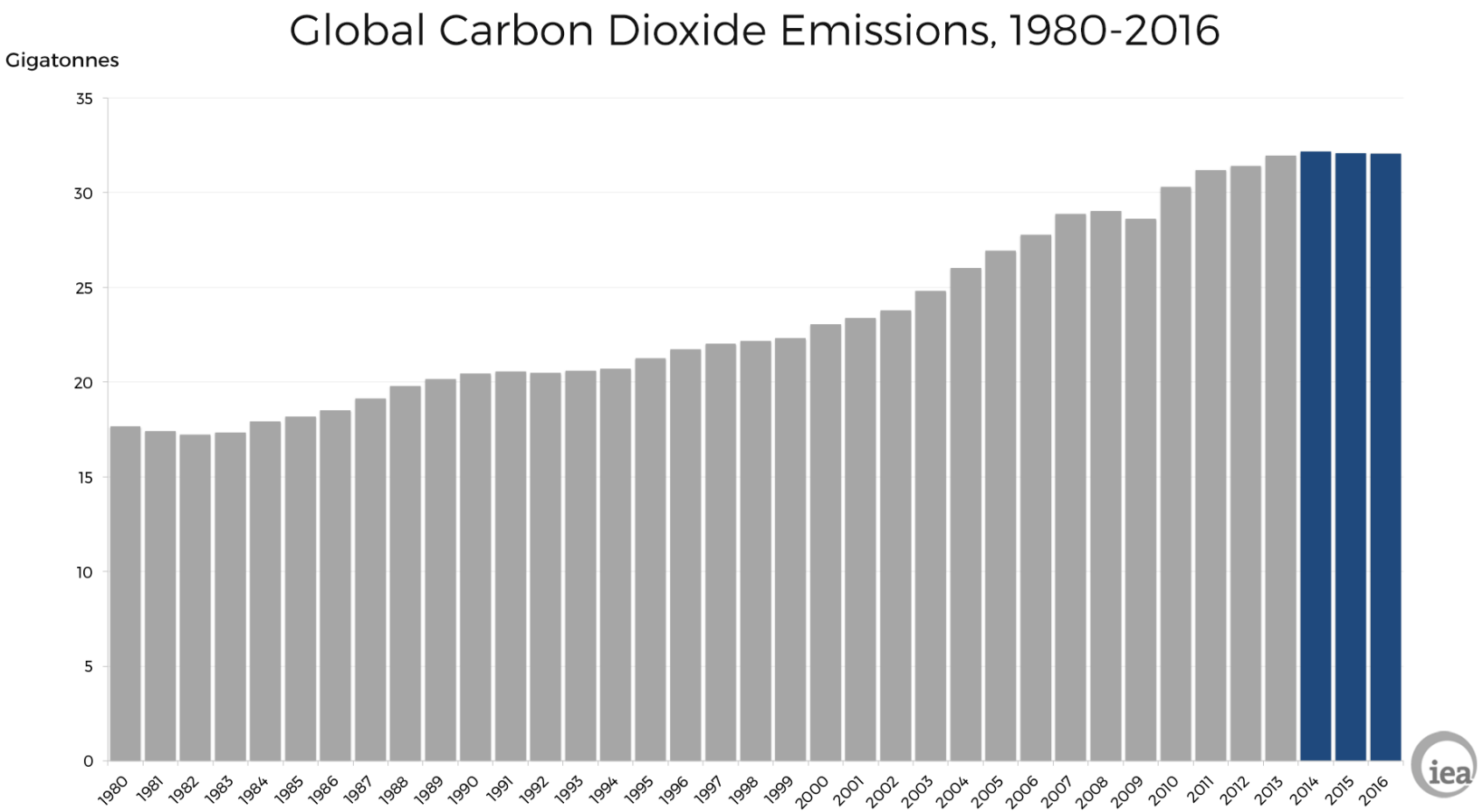
- IEA: Worldwide CO_2 emissions dropped in 2016 (and 2015)
- EPA: United States CO_2 emissions dropped in 2015
- IEA/EPA: Carbon emissions decoupling from economic growth
- EIA/EPA: Transportation emissions [almost] lower than electric sector emissions

public health

- AEA: EV emissions (from electricity) are less localized than ICE emissions (from tailpipe)

emissions

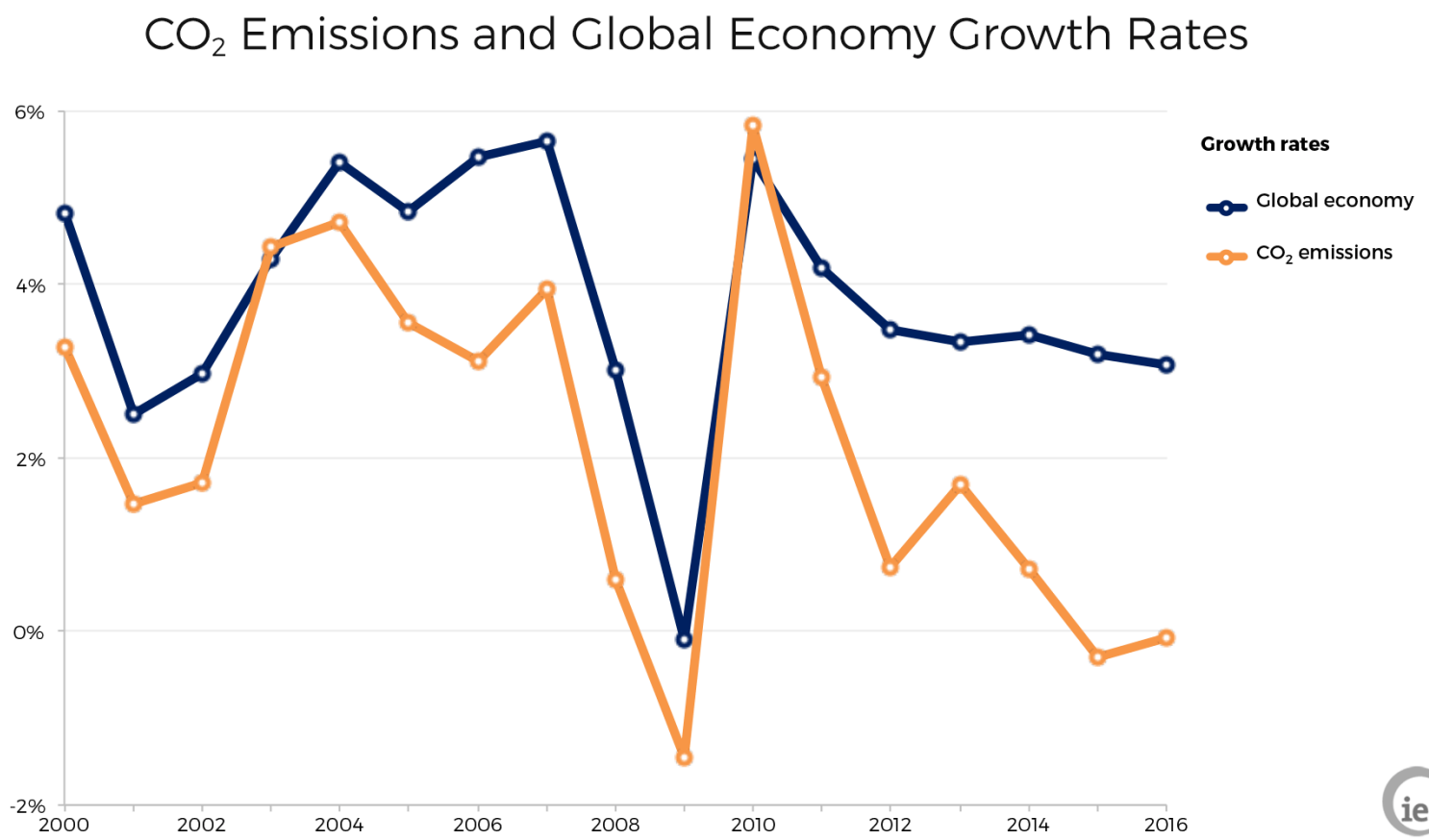
IEA: Worldwide carbon emissions dropped for second consecutive year in 2016



Source: http://www.iea.org/newsroom/news/2017/march/iea-finds-co2-emissions-flat-for-third-straight-year-even-as-global-economy-grew.html

emissions

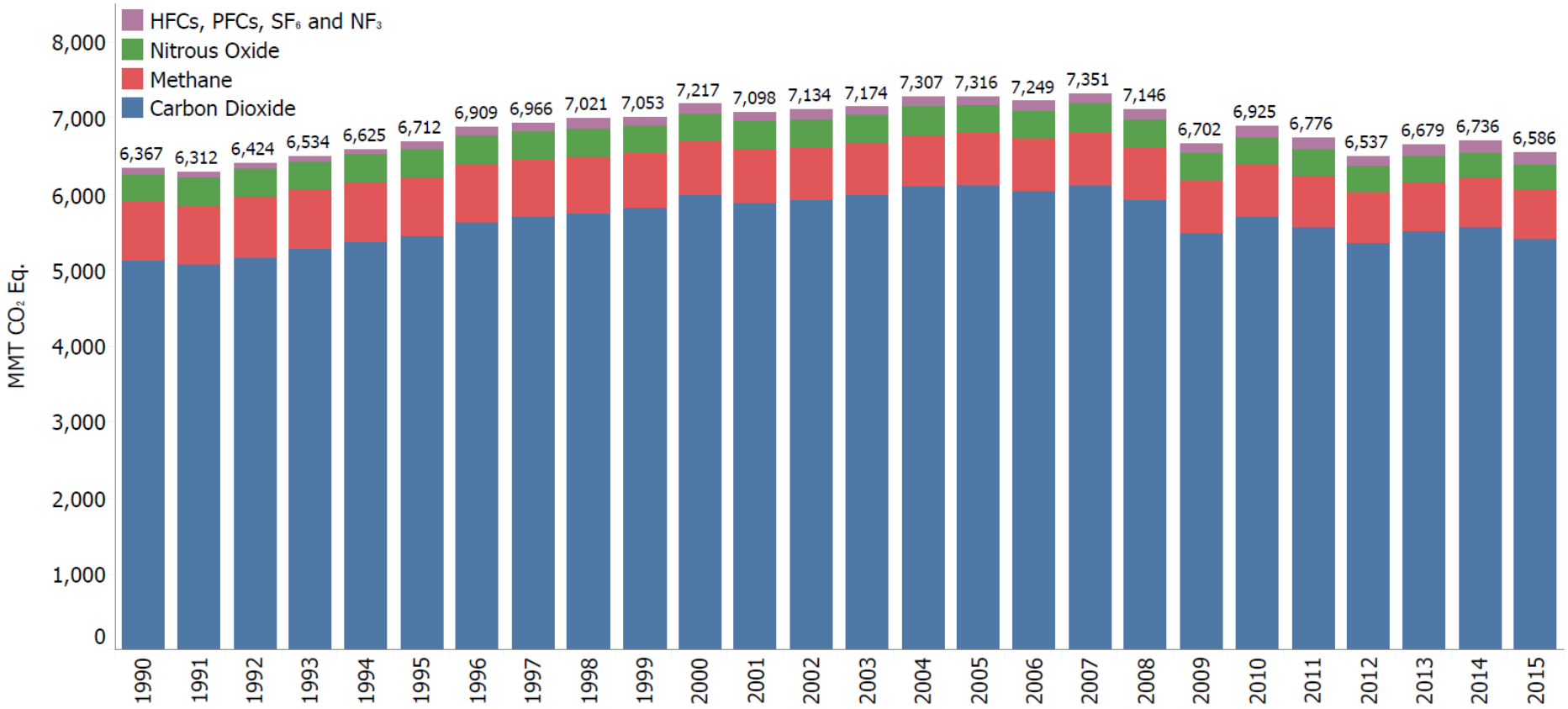
IEA: Worldwide carbon emissions are decoupling from economic growth



Source: http://www.iea.org/newsroom/news/2017/march/iea-finds-co2-emissions-flat-for-third-straight-year-even-as-global-economy-grew.html

emissions

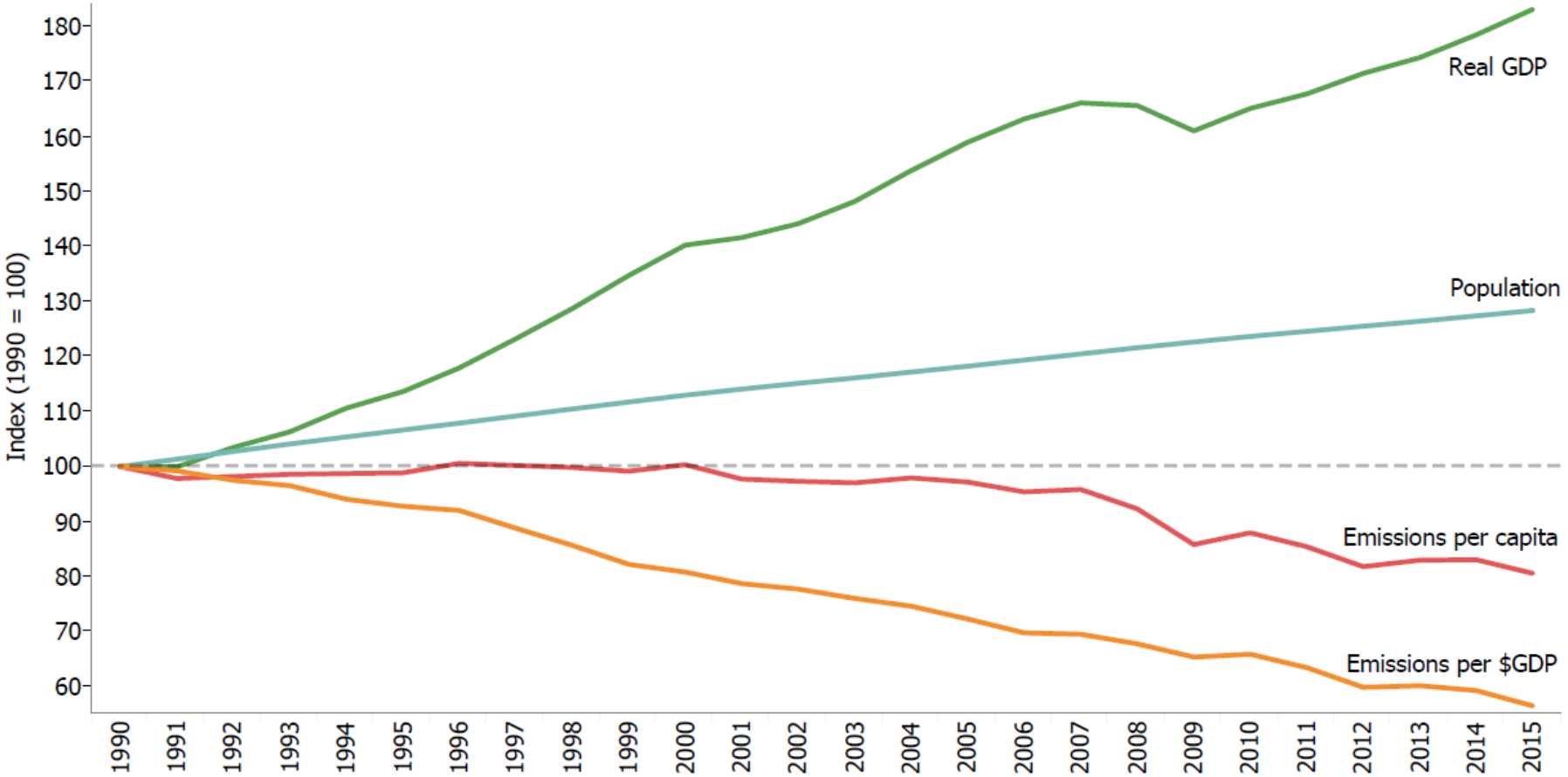
EPA: Total U.S. CO_2-equivalent emissions in 2015 similar to 2009 and 1994



Source: https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks

emissions

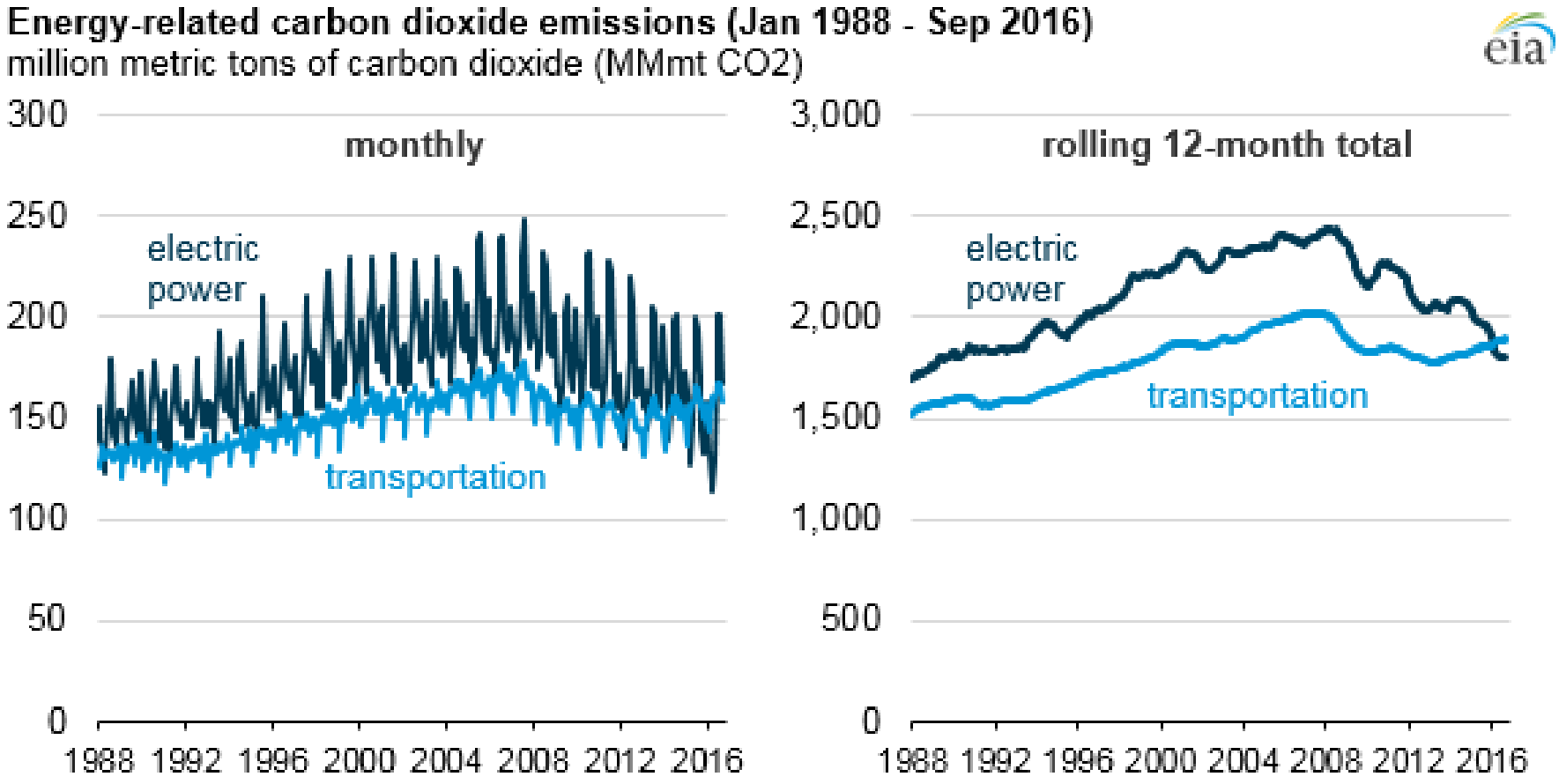
EPA: U.S. emissions per capita and emissions per GDP are at lowest levels in at least 25 years



Source: https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks

emissions

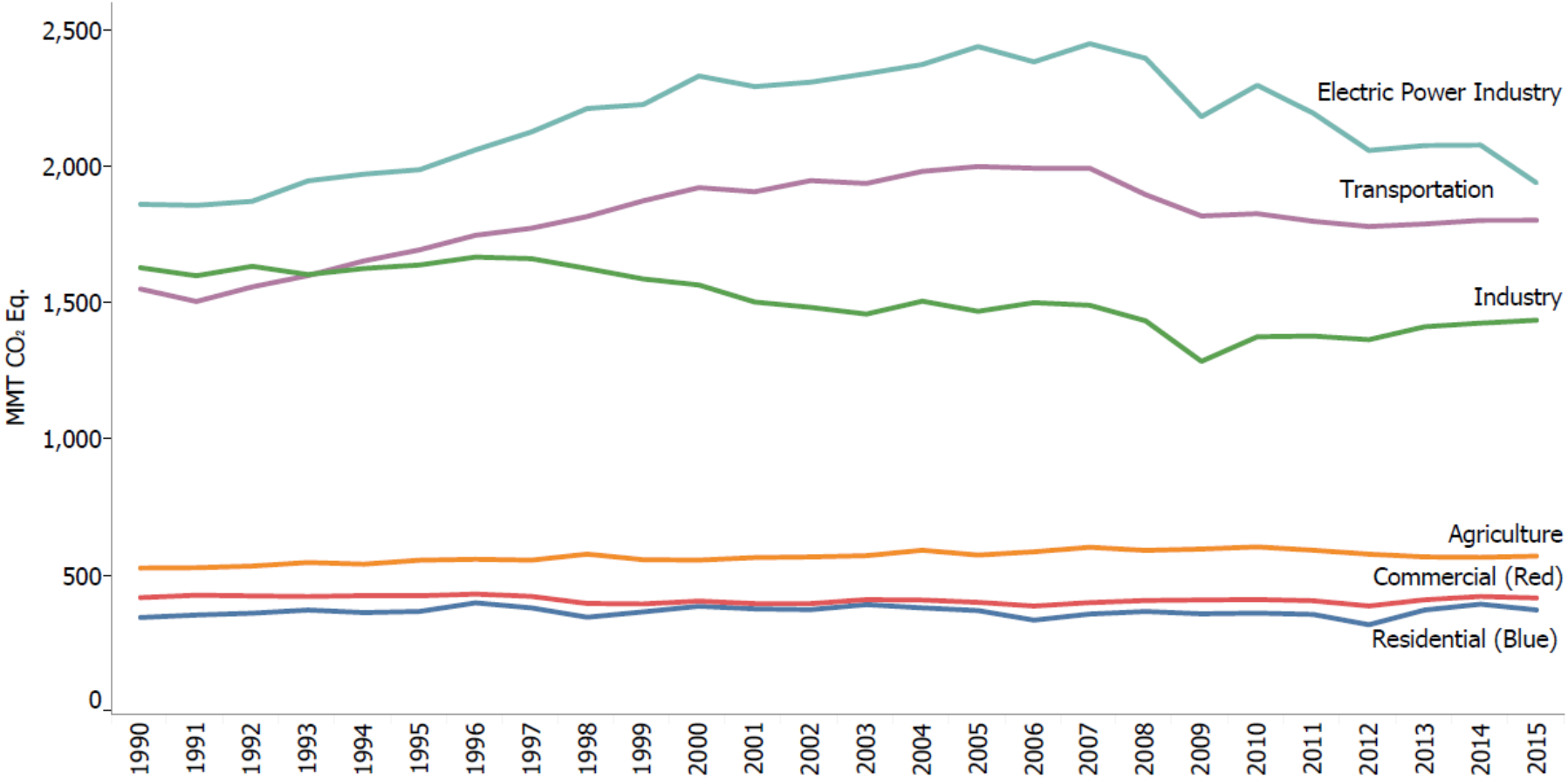
EIA: More CO_2 emissions from transportation sector than from electric power sector in United States



Source: https://www.eia.gov/todayinenergy/detail.php?id=29612

emissions

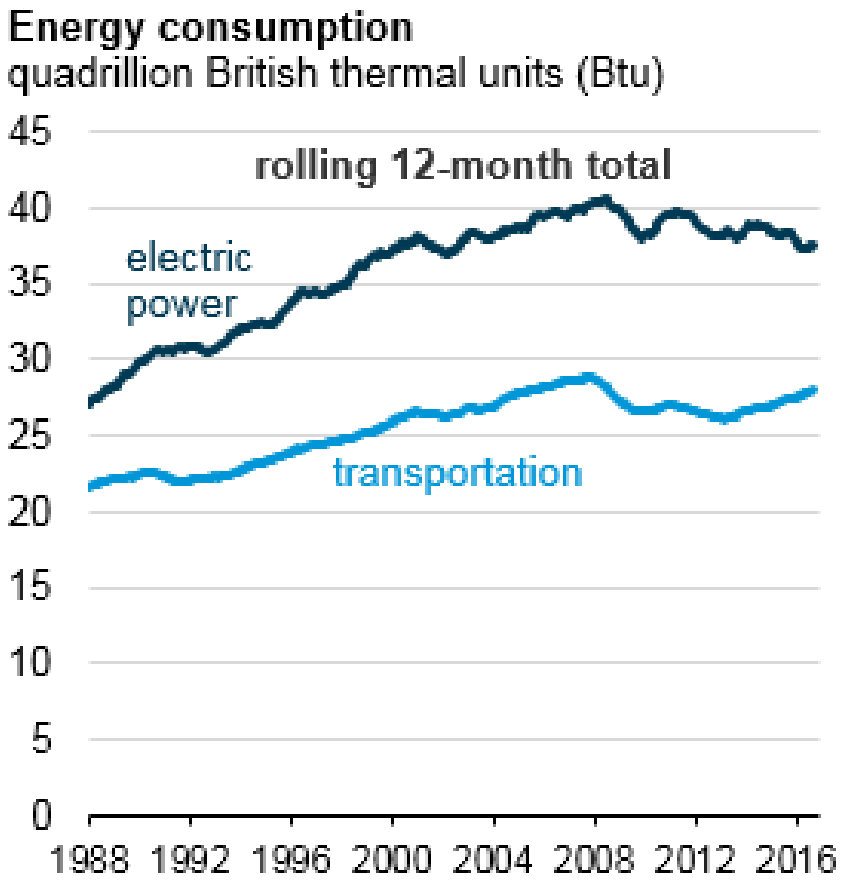
EPA: Electric power GHG (CO_2-*equivalent*) emissions still higher than transportation, but falling rapidly

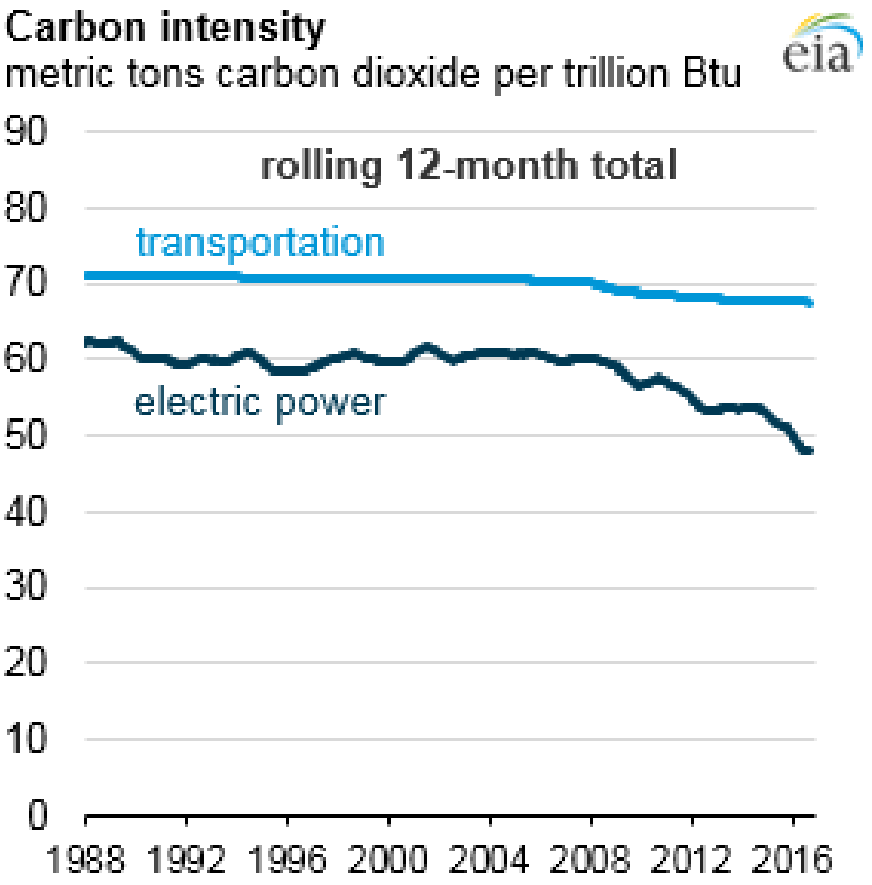


Source: https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks

emissions

EIA: Carbon intensity falling faster in electricity sector than in transportation sector in United States

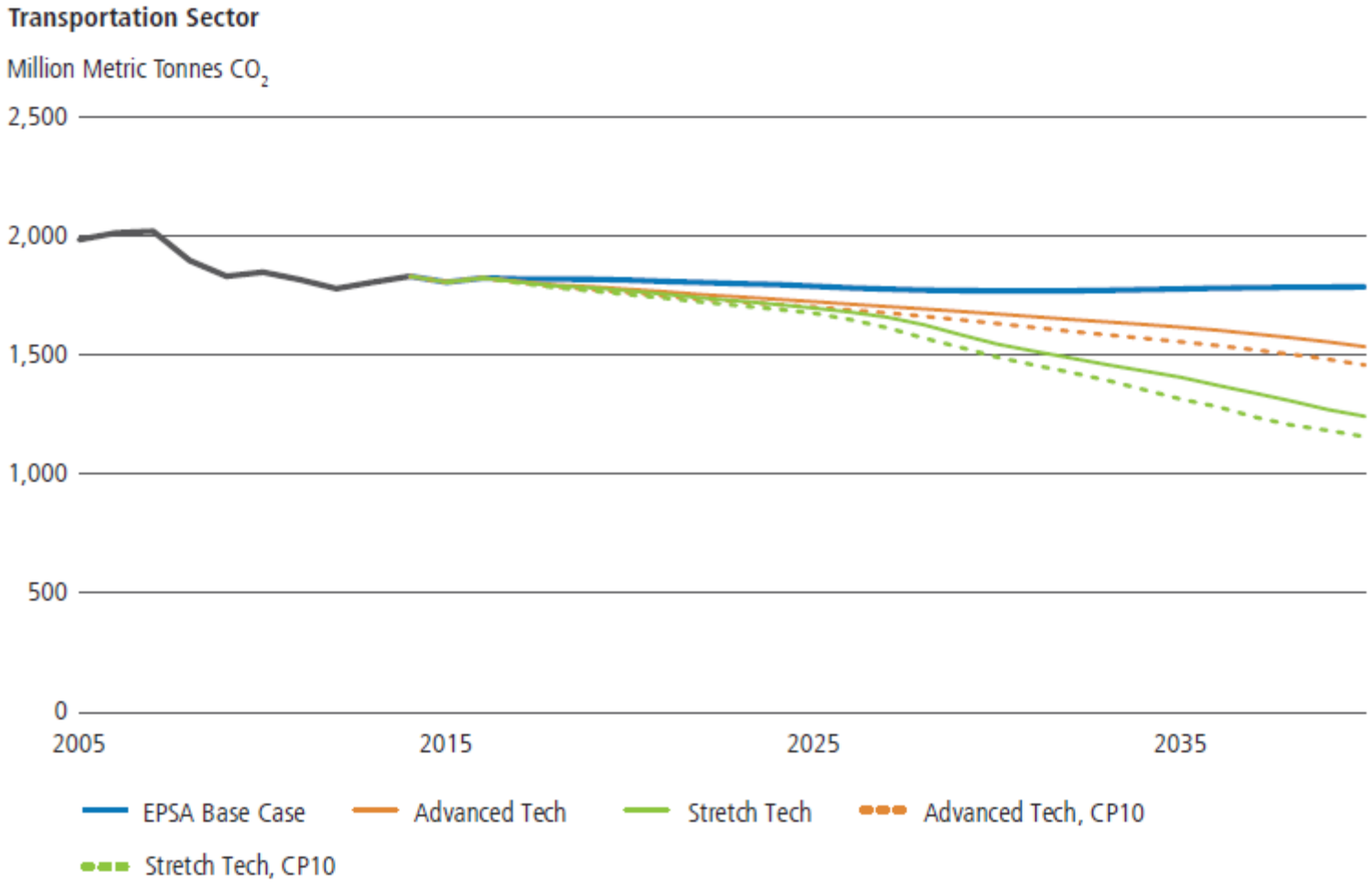




Source: https://www.eia.gov/todayinenergy/detail.php?id=29612

emissions

EPSA: Advancements in vehicle tech will have larger impact in transportation emissions than carbon tax



Source: https://www.energy.gov/epsa/quadrennial-energy-review-second-installment

emissions

AEA: Electric vehicles shift transportation emissions from driving locations (tailpipe) to broader geographic area (electric generation)

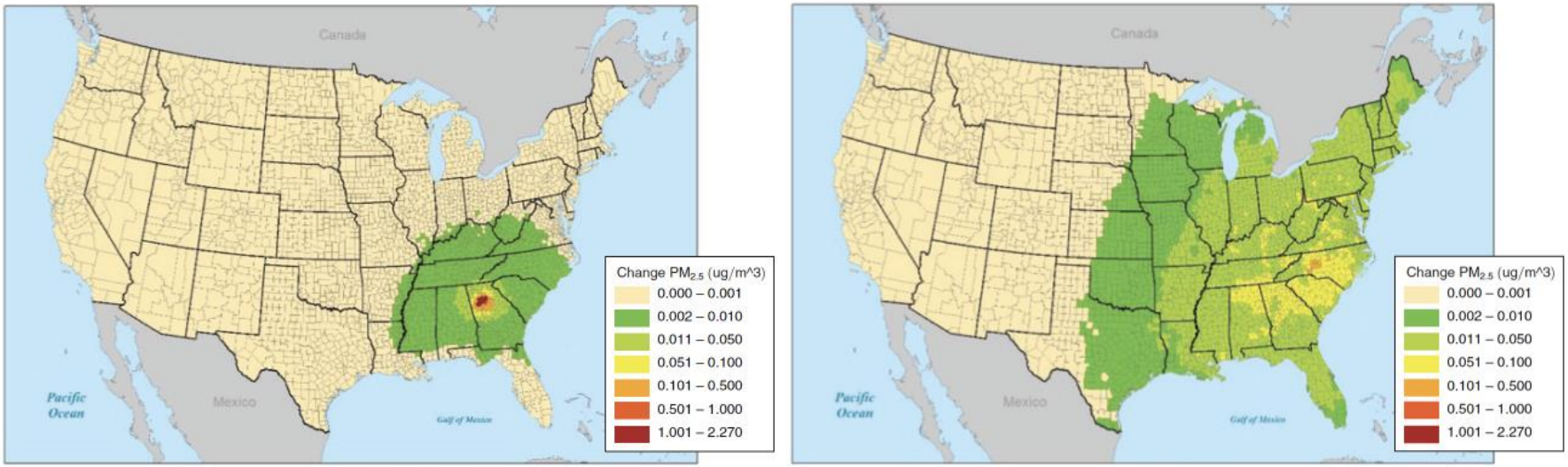


FIGURE 4. CHANGE IN $PM_{2.5}$ FROM GASOLINE VERSUS ELECTRIC VEHICLE IN FULTON COUNTY, GEORGIA

Source: https://www.aeaweb.org/research/charts/what-does-electric-car-atlanta-air-quality-maine

topics

energy markets

automotive markets

technologies studies

environmental studies

5 consumers & opinion surveys

policy & business studies

qar

outline

5 consumer & opinion surveys

purchasing behavior

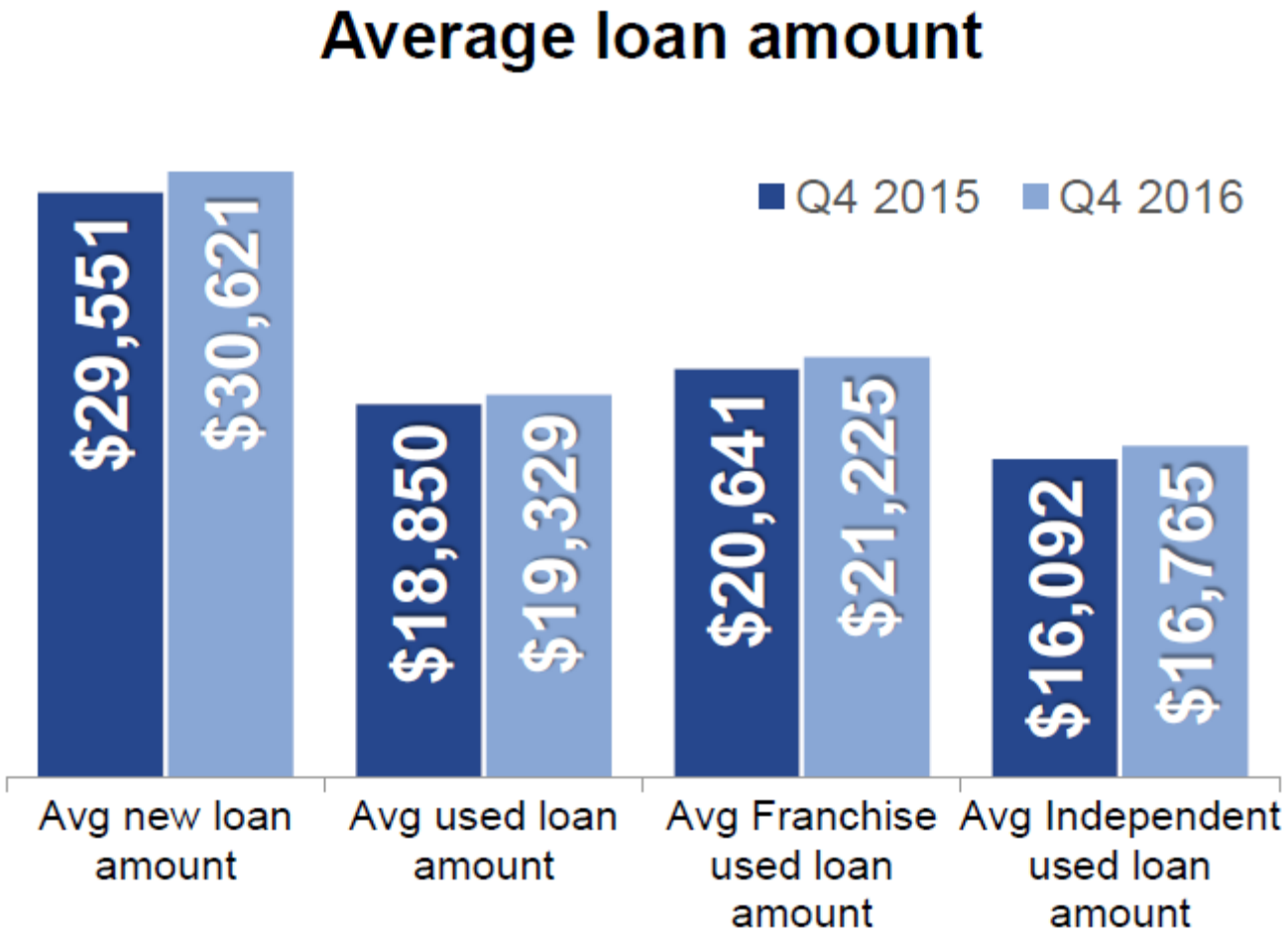
- Experian: Vehicle financing cost at all-time high
- McKinsey: Prospective EV buyers in U.S. have lower income than current EV buyers
- McKinsey: EV buyers in China have lower income than ICE buyers
- Deloitte: Interest is rising in AV technologies

travel behavior

- FHWA: VMT at all-time high in 2016
- Uber: Modal shift from transit can lead to increased congestion
- Certify: Uber is now half of itemized expenses for ground transportation

purchasing behavior

Experian: Average vehicle loan amount at all-time high for both new and used vehicles

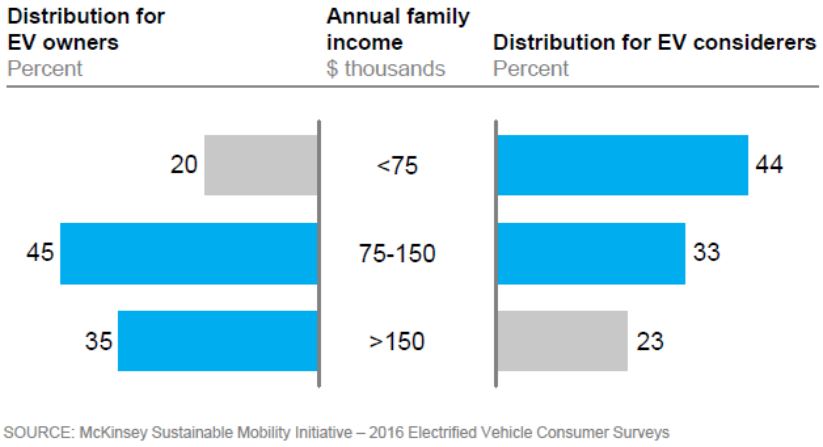


Source: http://www.experian.com/automotive/automotive-credit-webinar.html

purchasing behavior

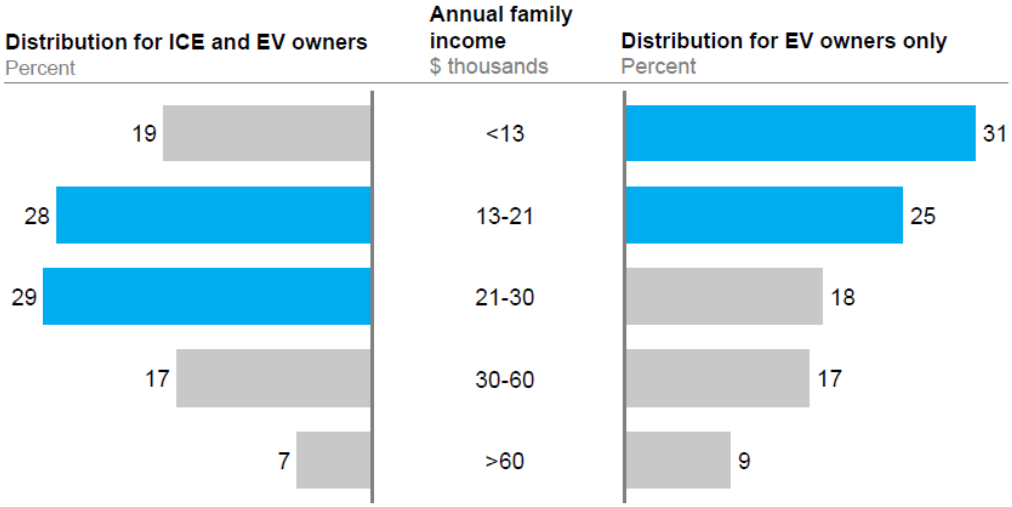
McKinsey: Prospective EV buyers have lower incomes than current in U.S.; EV buyers in China already lower income than average new car buyer

Income of current and future EV owners, US example



SOURCE: McKinsey Sustainable Mobility Initiative – 2016 Electrified Vehicle Consumer Surveys

Income distribution of survey respondents in China, 2016

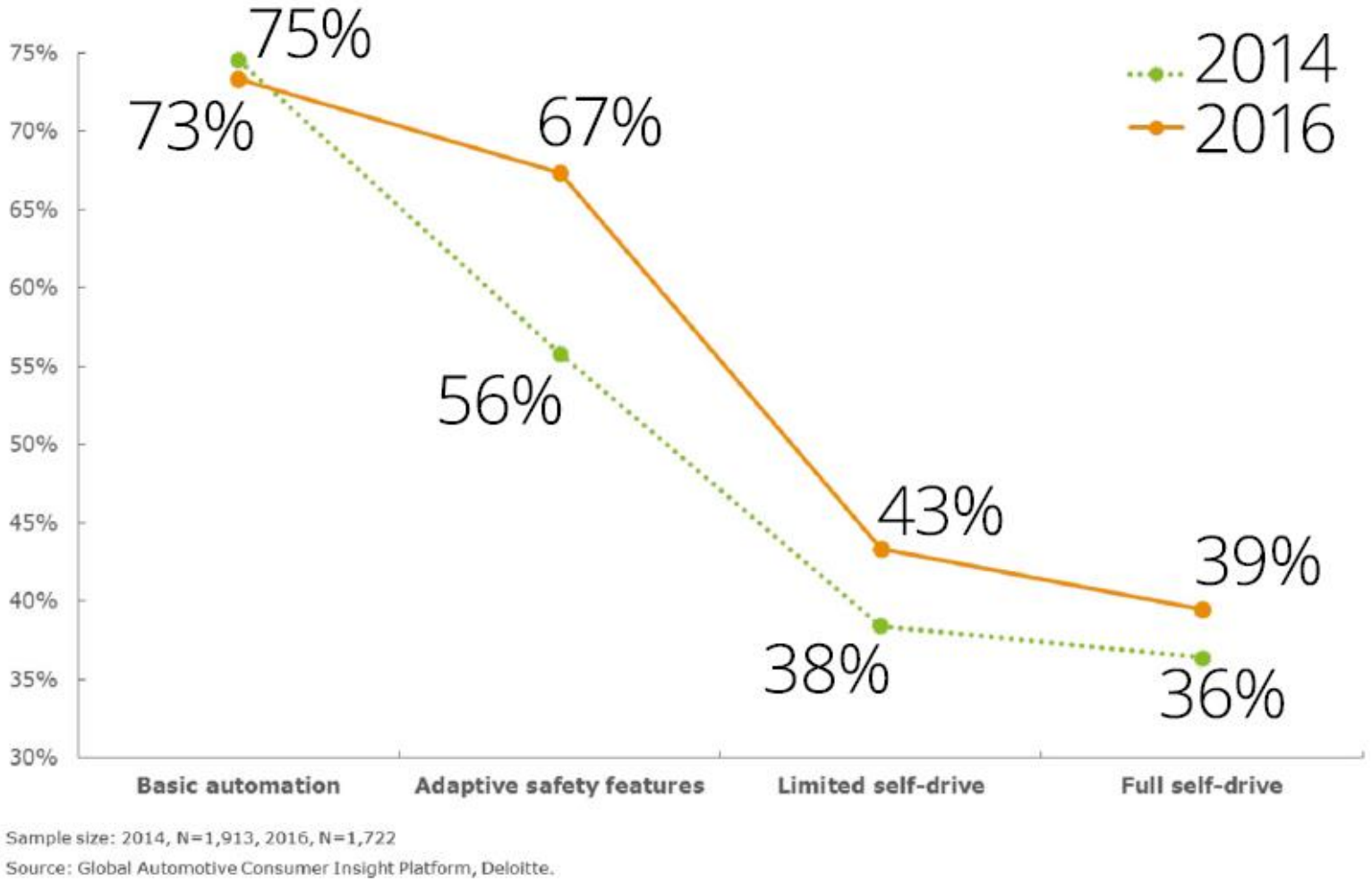


SOURCE: McKinsey Sustainable Mobility Initiative – 2016 Electrified Vehicle Consumer Surveys

Source: http://www.mckinsey.com/industries/automotive-and-assembly/our-insights/electrifying-insights-how-automakers-can-drive-electrified-vehicle-sales-and-profitability

CAVs views

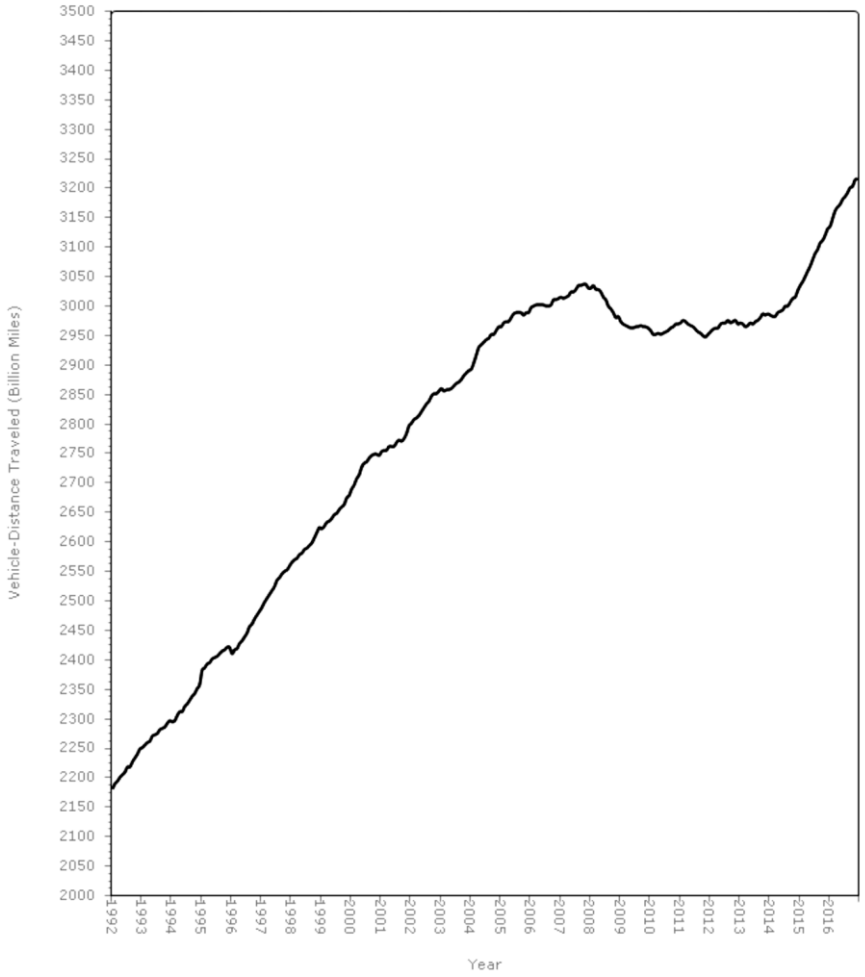
Deloitte: Consumer interest in vehicle automation technologies is rising

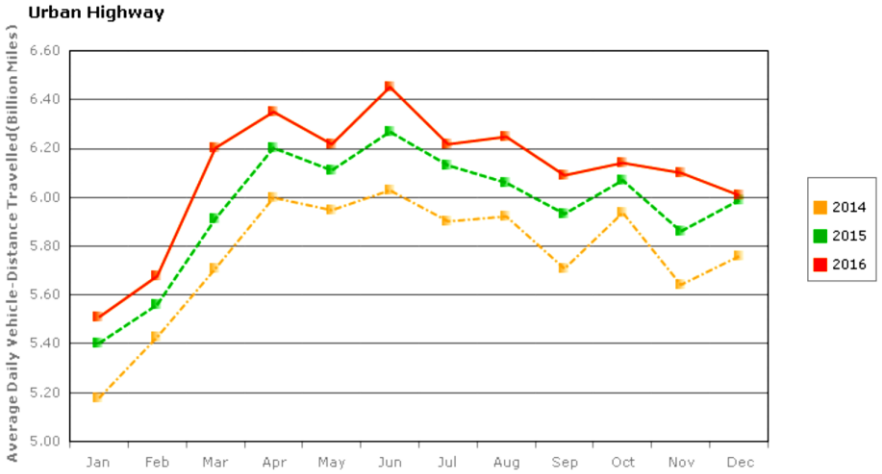


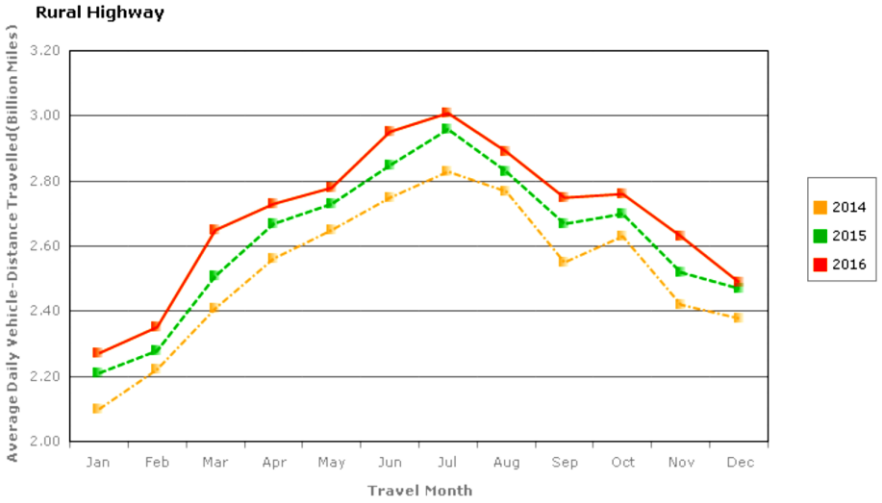
Source: https://www2.deloitte.com/content/dam/Deloitte/us/Documents/manufacturing/us-auto-the-race-to-autonomous-driving.pdf

travel behavior

FHWA: VMT set new high in 2016, increased travel on both urban and rural roads



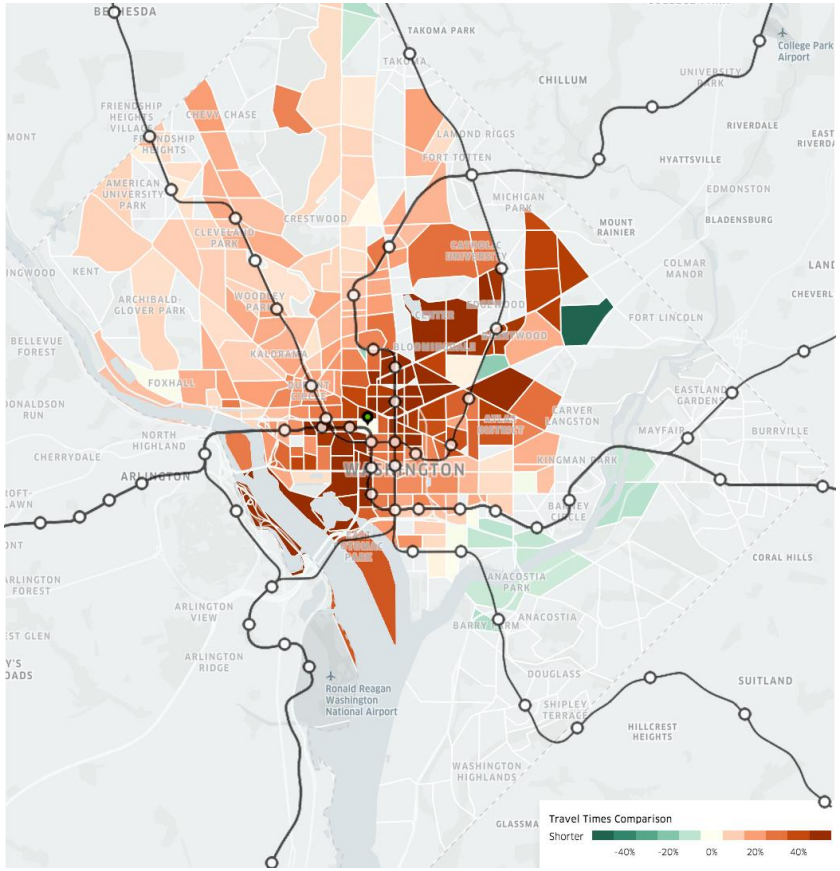


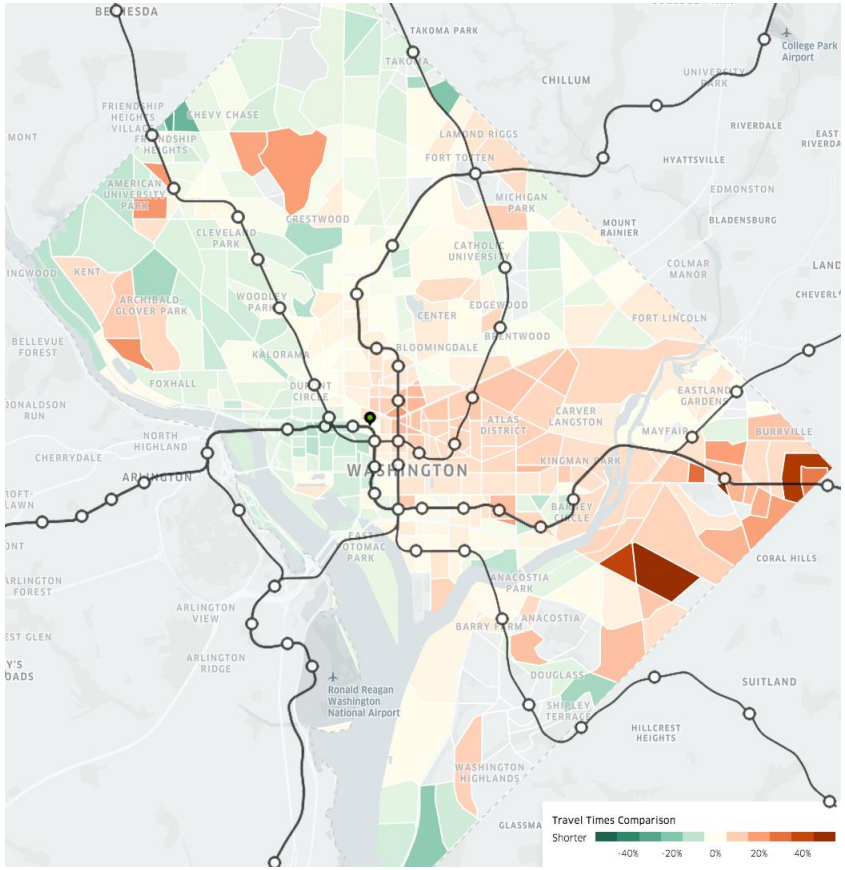


Source: https://www.fhwa.dot.gov/policyinformation/travel_monitoring/16dectvt/16dectvt.pdf

modal choice

Uber: Typical local travel times increased by up to 50% when DC Metro was shut down; SafeTrack leads to localized congestion

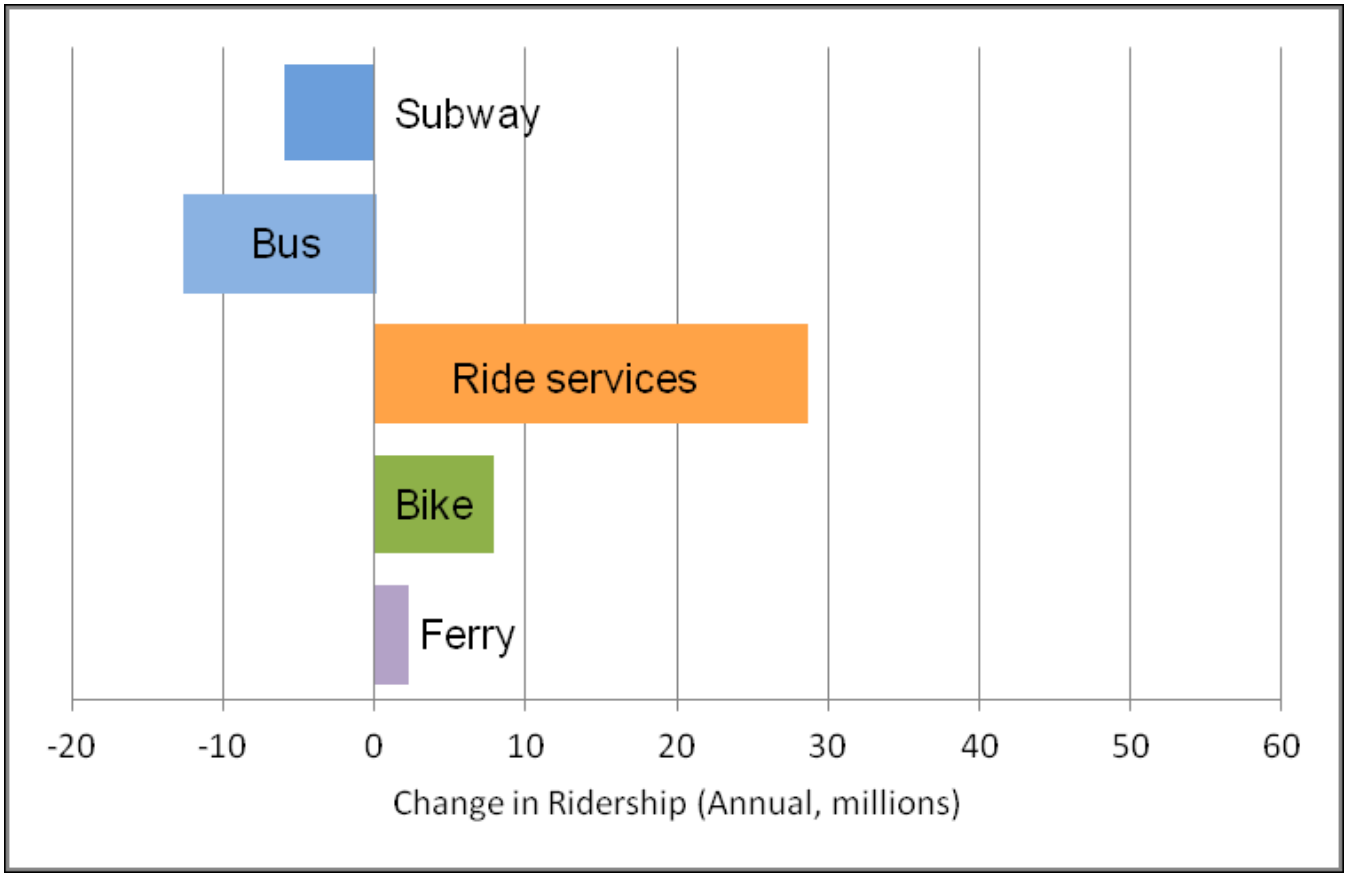




Source: https://movement.uber.com/use-case/dc

modal choice

Schaller: Ride services (taxi + TNC) adding rides to roadways; may be taking rides from public transit

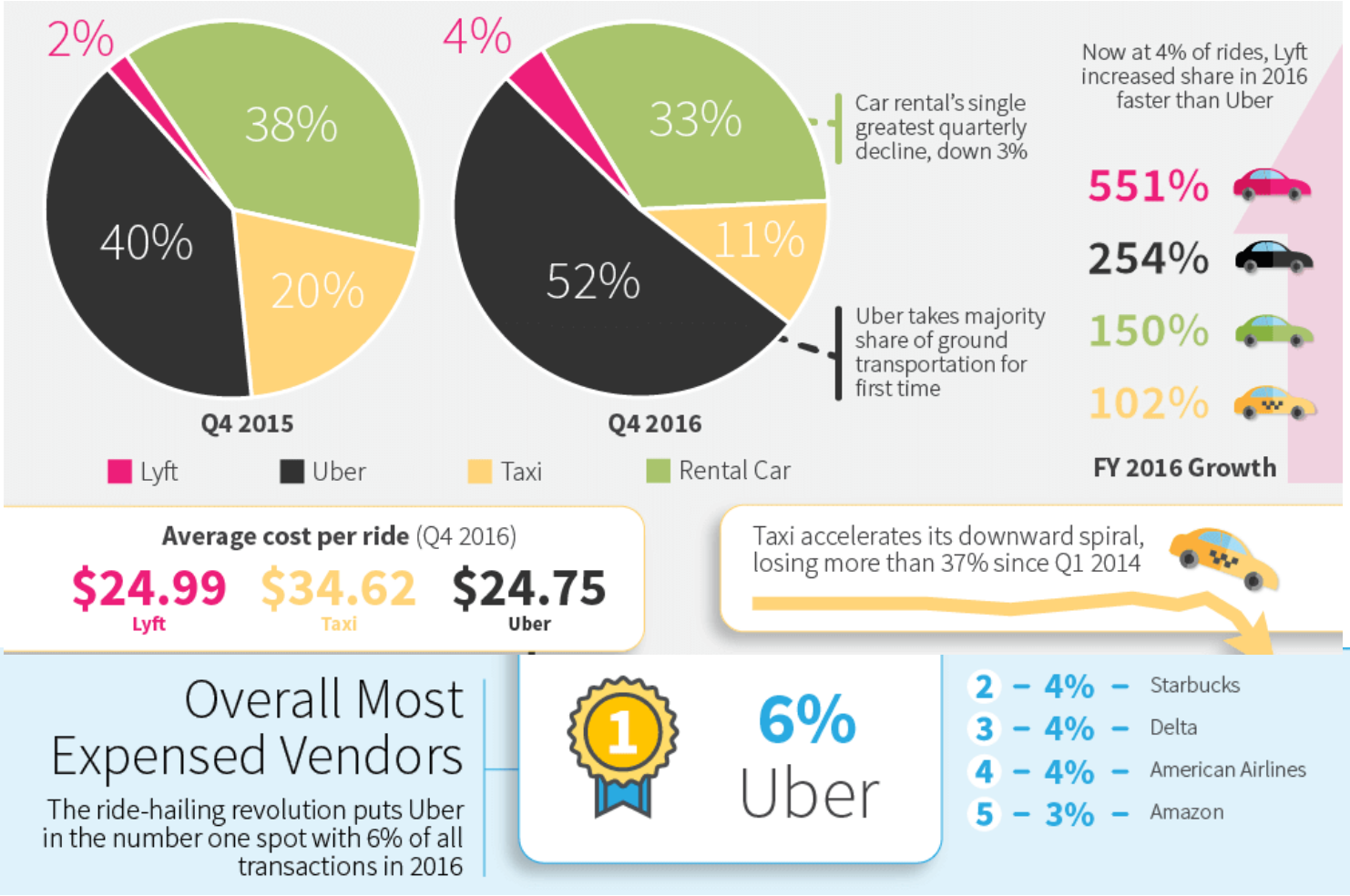


Changes in Ridership by Mode, 2015 to 2016

Source: http://www.schallerconsult.com/rideservices/unsustainable.pdf

modal choice

Certify: Uber ridership made up over half of reported business expenses for ground transportation in Q4



Source: http://www.certify.com/Certify-SpendSmart-Report-Infographic-FY-2016.aspx

topics

energy markets

automotive markets

technologies studies

environmental studies

consumers & opinion surveys

6 policy & business studies

qar

outline

6 policy & business studies

safety

> NSC: Fatal accidents up for second year in a row
> NHTSA: V2V communications are proposed to be required soon
> NHTSA: Vehicle recalls hit record high for third year in a row

fuel economy standards

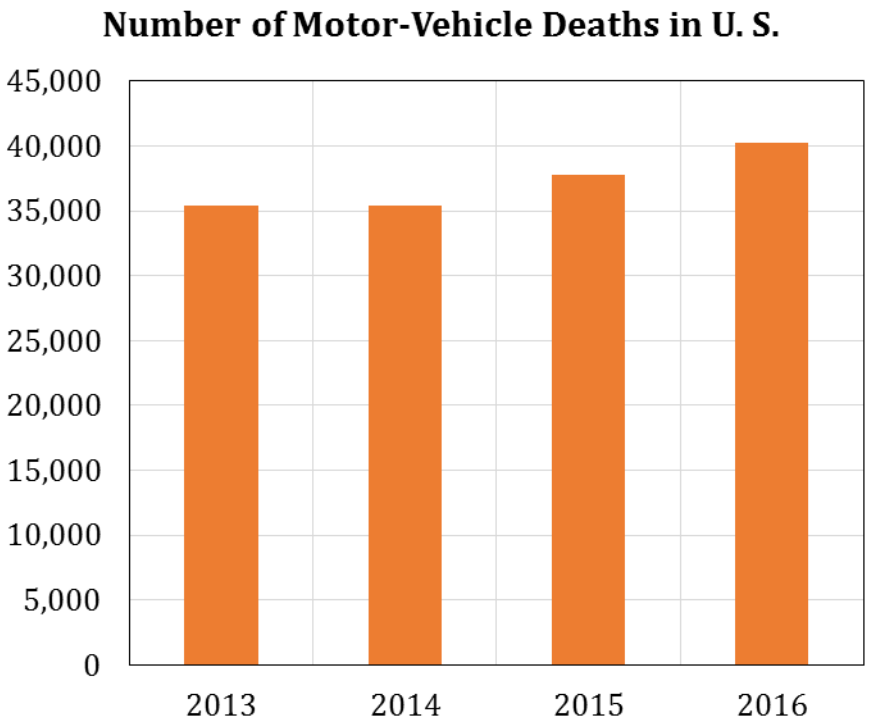
> NHTSA: MY2016 vehicles likely did not reach CAFE standards
> IU: 2022–25 GHG standards may lead to short-term negative economic impacts but long-term increased employment

business studies

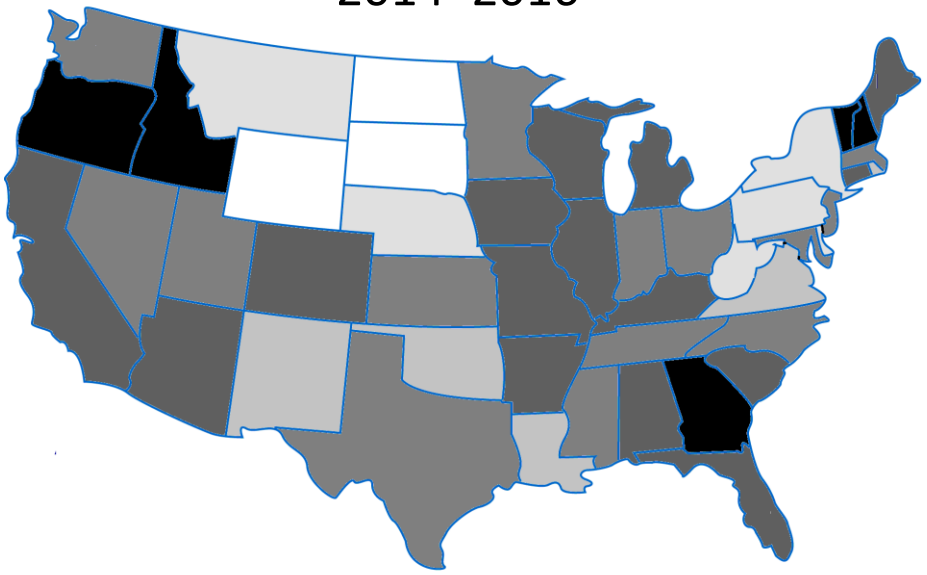
> Truckerpath: Trucking is important to U.S. economy
> KPMG: Auto executives view EVs as most important key trend until 2025, but view (SI) ICEs has more important in short term and diesels as dead

safety

NSC: Auto fatalities up 6% in 2016 nationwide; decline in auto fatalities in some North Central and Northeast states



Percentage change in fatal accidents, 2014–2016

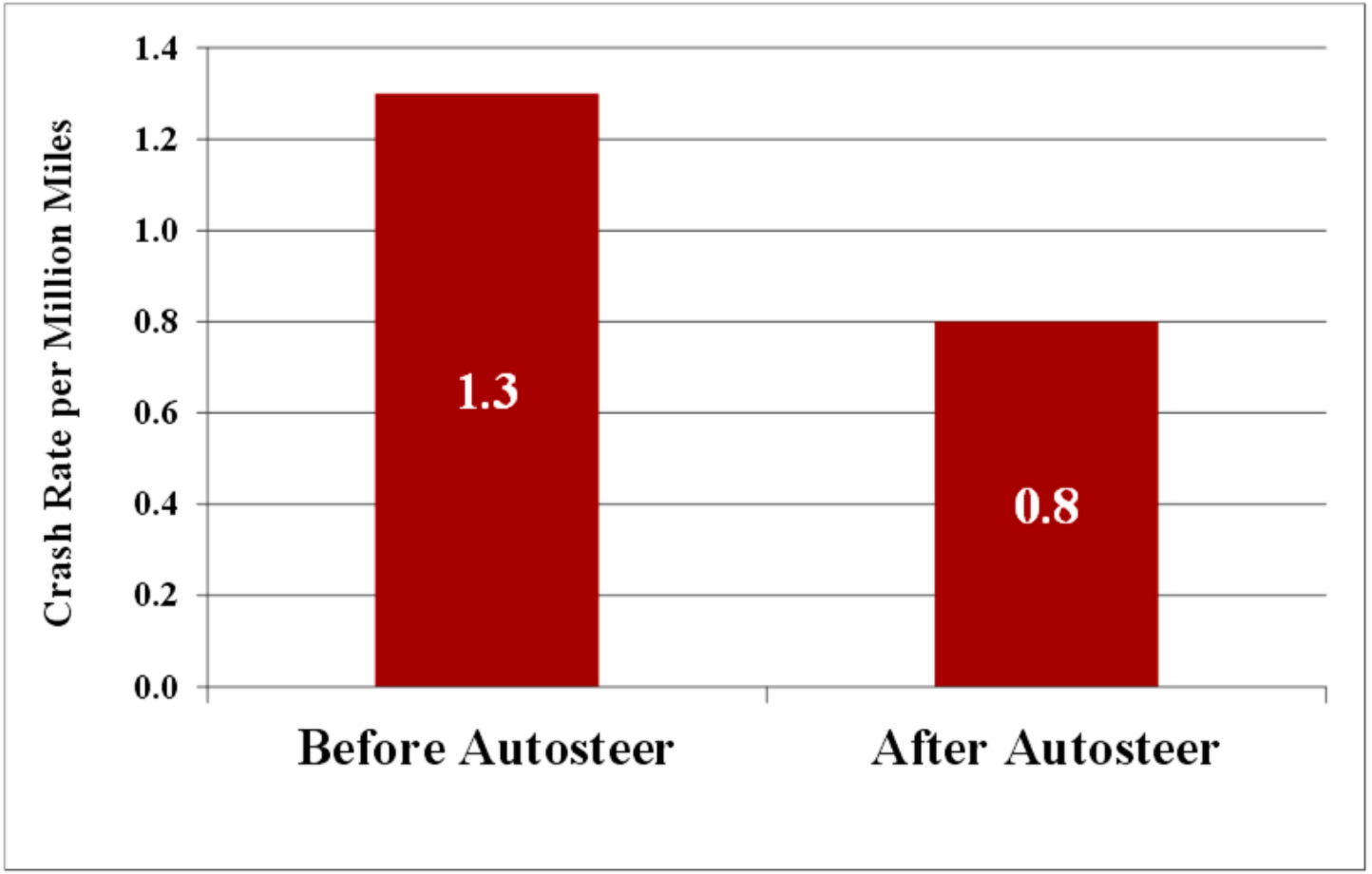


-25% to -15%	-8% to -1%	+2% to +7%
+8% to +15%	+17% to +30%	+34% to +49%

Source: http://www.nsc.org/NewsDocuments/2017/12-month-estimates.pdf

safety (automation)

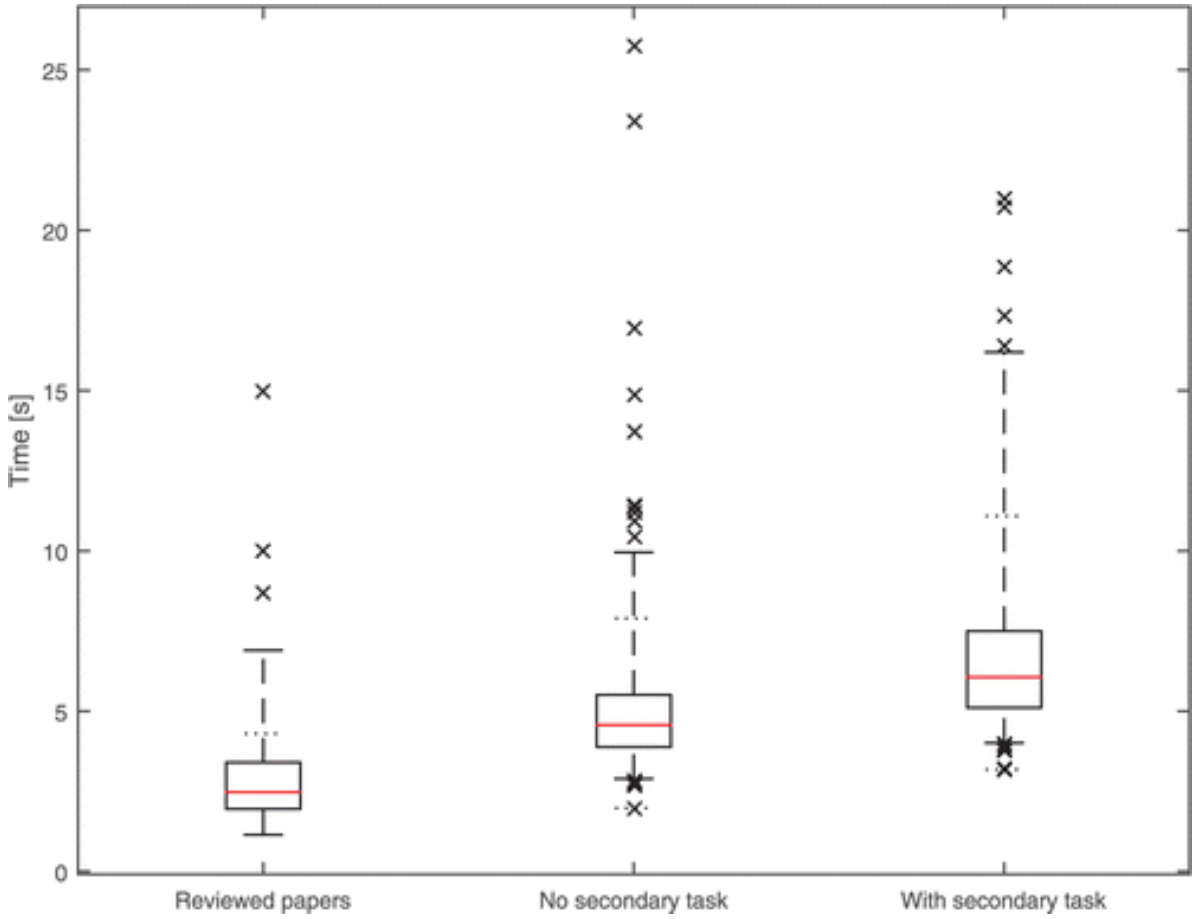
NHTSA: Crashes in Teslas dropped nearly 40% after Autosteer (SAE Level 2 automation) installed



Source: https://static.nhtsa.gov/odi/inv/2016/INCLA-PE16007-7876.PDF

safety (automation)

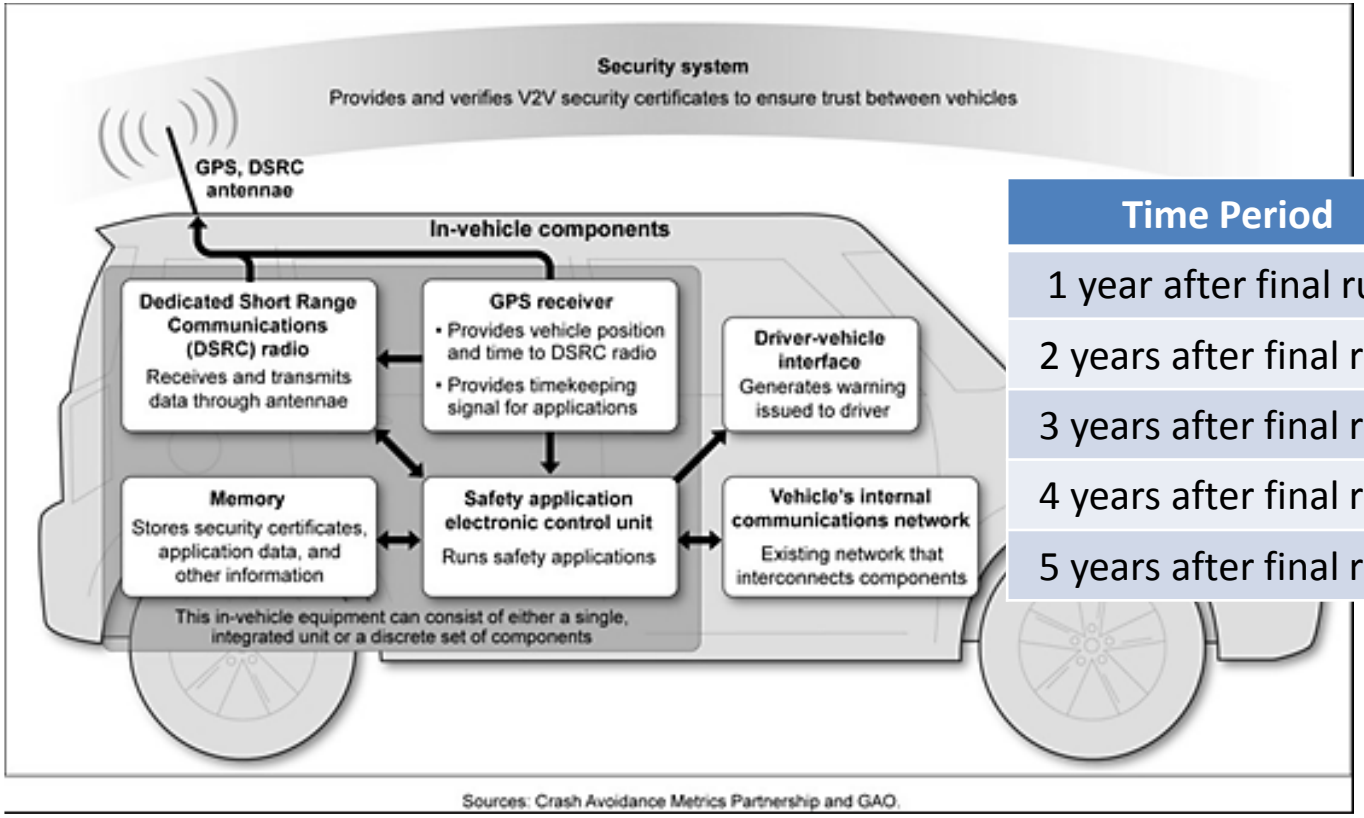
Southampton via GCC: Takeover reaction time can be nearly half a minute in some cases



Source: http://www.greencarcongress.com/2017/01/20170126-tor.html

safety (connectivity)

NHTSA: Vehicle-to-Vehicle (V2V) communications proposed to be required soon



Time Period	Percentage of Vehicles
1 year after final rule	0%
2 years after final rule	0%
3 years after final rule	50%
4 years after final rule	75%
5 years after final rule	100%

Source: https://www.nhtsa.gov/press-releases/us-dot-advances-deployment-connected-vehicle-technology-prevent-hundreds-thousands

safety (connectivity)

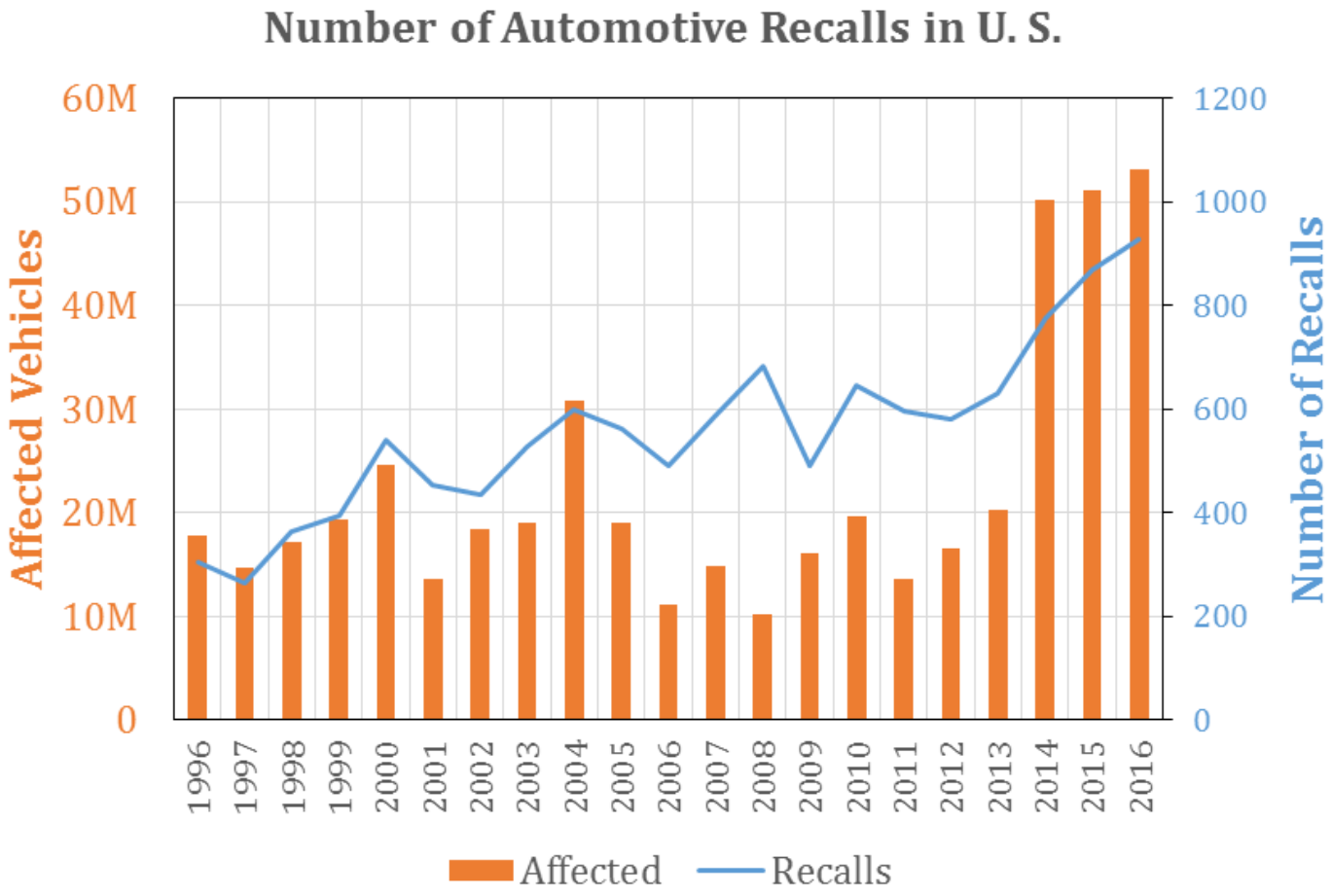
NHTSA: Additional weight of V2V radios adds slight amount to lifetime fuel usage

Year	Model Year	Gallons per Vehicle	Total Gallons	Per Vehicle Cost (3%)	Per Vehicle Cost (7%)
1	2021	*0.83*	13.38 M	*$2.02*	*$1.55*
2	2022	*1.22*	19.88 M	*$3.02*	*$2.31*
3	2023	1.58	26.01 M	$3.97	$3.04
4	2024	1.54	25.52 M	$3.93	$3.00
5	2025	1.49	24.80 M	$3.83	$2.93
6	2026	1.50	25.07 M	$3.90	$2.98
7	2027	1.50	25.39 M	$3.97	$3.03
8	2028	1.51	25.74 M	$4.03	$3.08
9	2029	1.52	26.03 M	$4.11	$3.14
10	2030	1.53	26.42 M	$4.18	$3.19

Source: https://www.nhtsa.gov/press-releases/us-dot-advances-deployment-connected-vehicle-technology-prevent-hundreds-thousands

safety (reliability)

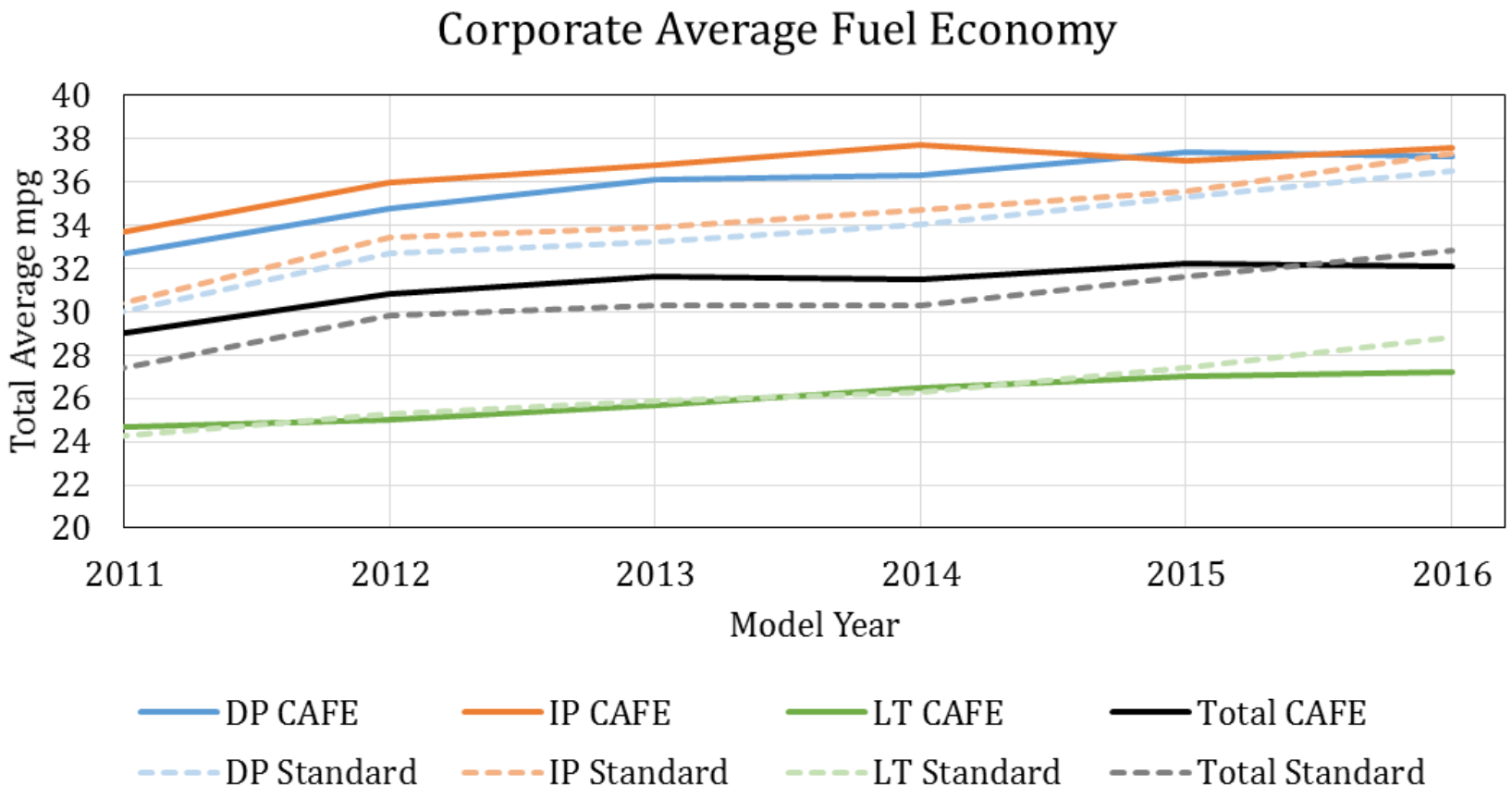
NHTSA: Vehicle recalls hit record high for third year in a row in 2016: 53.2 million



Source: https://www.transportation.gov/fastlane/spring-forward-then-check-vehicle-recalls

fuel economy standards

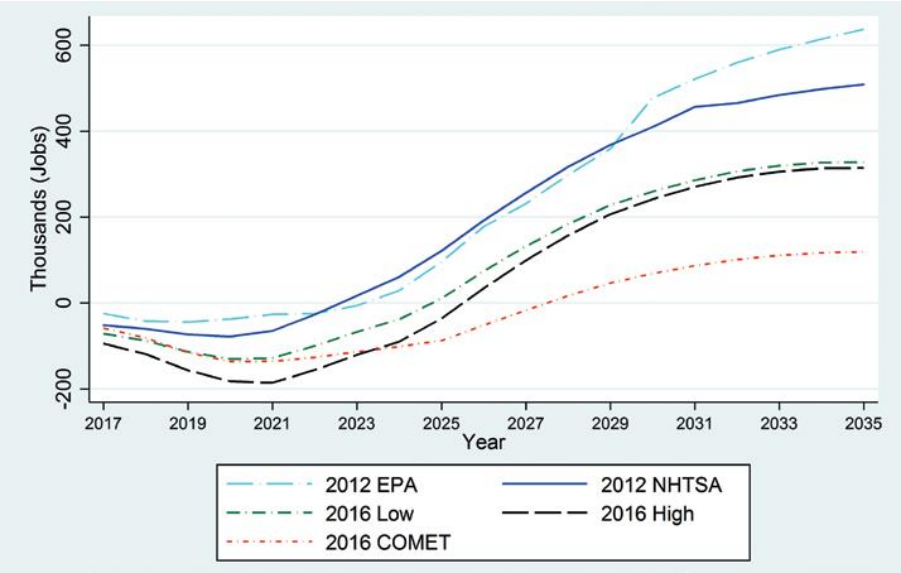
NHTSA via EEnews: Automakers projected to miss CAFE standards for MY2016 vehicles (and light trucks)



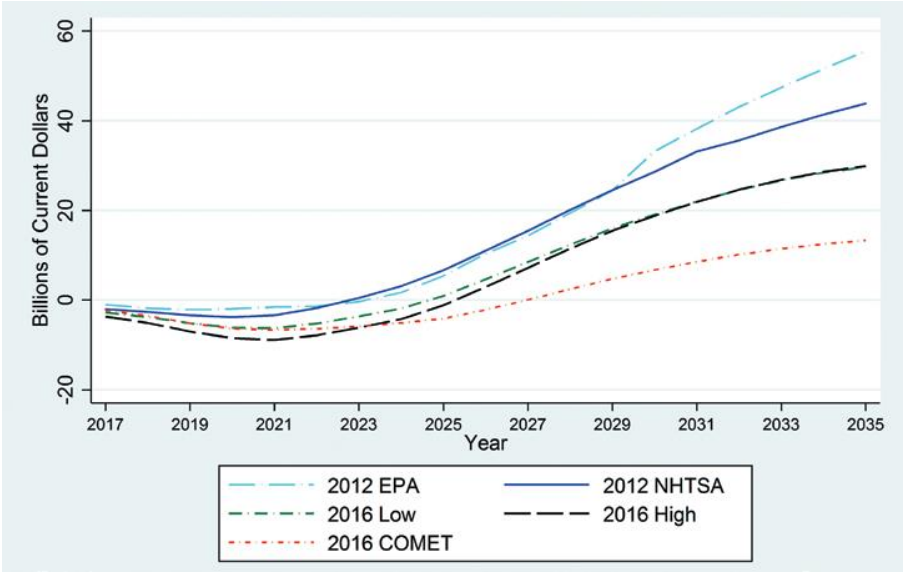
Sources: http://www.eenews.net/greenwire/2017/03/09/stories/1060051220 and http://www.eenews.net/assets/2017/03/09/document_gw_11.pdf and https://one.nhtsa.gov/cafe_pic/CAFE_PIC_fleet_LIVE.html and https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/my_2015_and_2016_projected_fuel_economy_performance_report_final.pdf

fuel economy standards

IU: Fuel economy standards lead to negative economic impacts in short term, positive net impacts by mid- to late-2020s



Difference in Employment Between Baseline and Combined Regulatory Scenarios

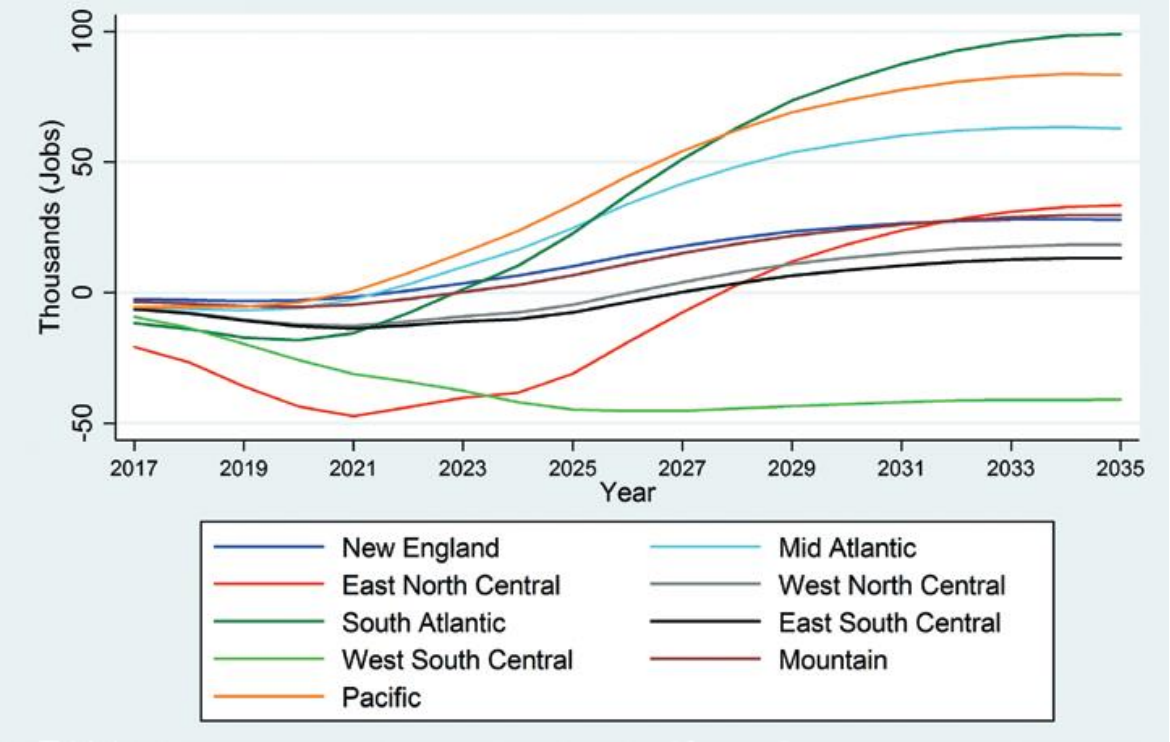


Difference in Disposable Personal Income Between Baseline and Combined Regulatory Scenarios

Source: http://news.iu.edu/releases/iu/2017/03/fuel-mileage-standards.shtml

fuel economy standards

IU: More job losses in West South Central region due to less oil consumption, deeper and earlier impacts in East North Central due to manufacturing

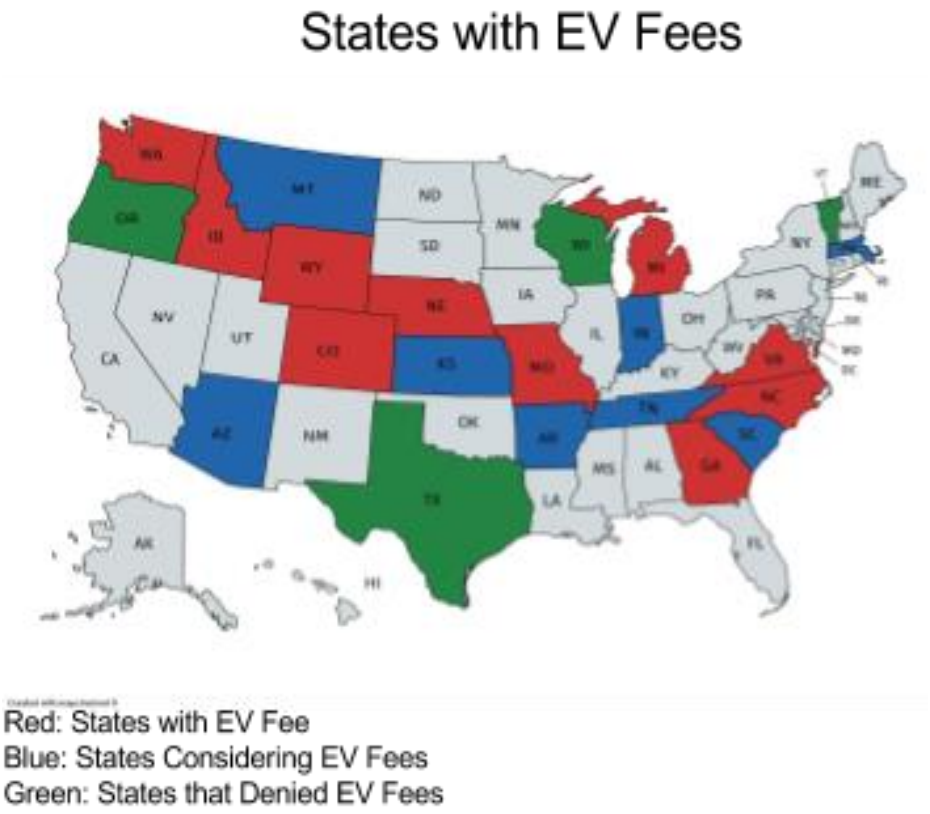


Difference in Employment between Baseline and Combined Regulatory Scenarios, by Region (2016 Perspective Low)

Source: http://news.iu.edu/releases/iu/2017/03/fuel-mileage-standards.shtml

EV fees

Sierra Club: Several states considering EV registration fees; current registration fees typically (but not always) comparable to lost gas tax revenue



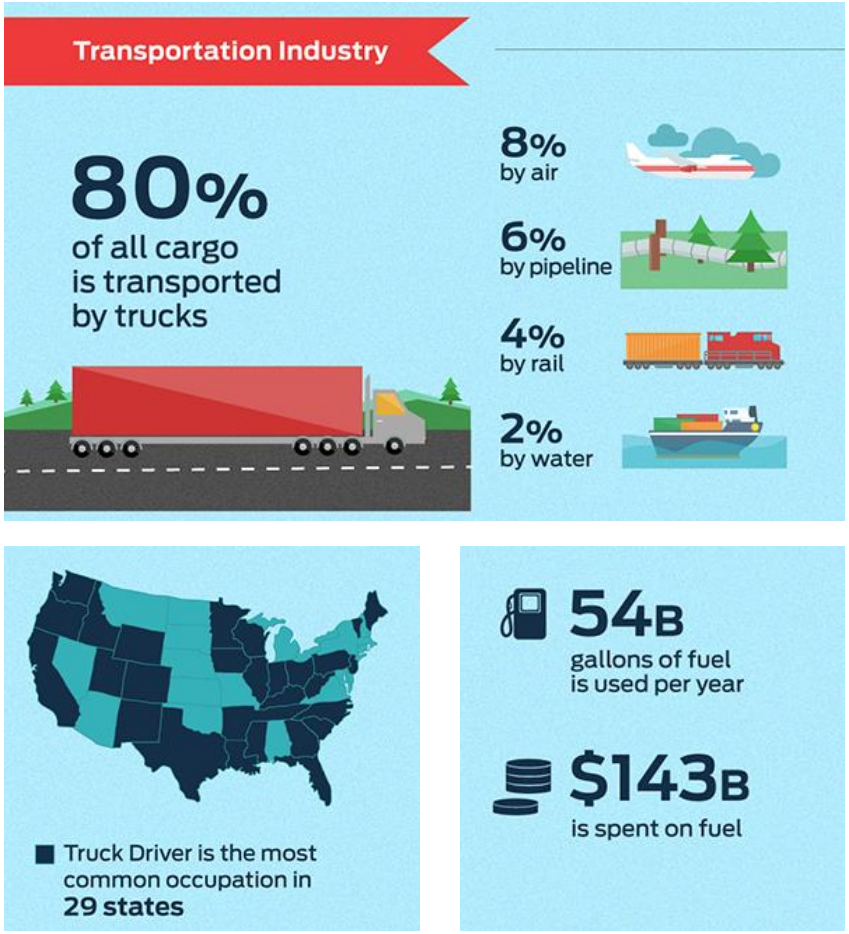
State Gasoline Taxes (Cents per Gallon)				EV Fees		
State	Excise Tax	Additional Fee or Tax	Total	PEV fee	Gasoline gallons offset	Gasoline mileage equivalent
Georgia	7.5	11.8	19.3	$200.00	1036	36269
Idaho	25.0	1.0	26.0	$150.00	577	20192
Michigan	19.0		19.0	$100.00	526	18421
Missouri	17.0	0.3	17.3	$75.00	434	15173
Virginia (1)	16.2		16.2	$64.00	395	13827
Nebraska	25.6	0.9	26.5	$75.00	283	9906
Washington	37.5		37.5	$100.00	267	9333
North Carolina	37.5	0.3	37.8	$100.00	265	9272
Colorado	22.0		22.0	$50.00	227	7955
Wyoming	23.0	1.0	24.0	$50.00	208	7292

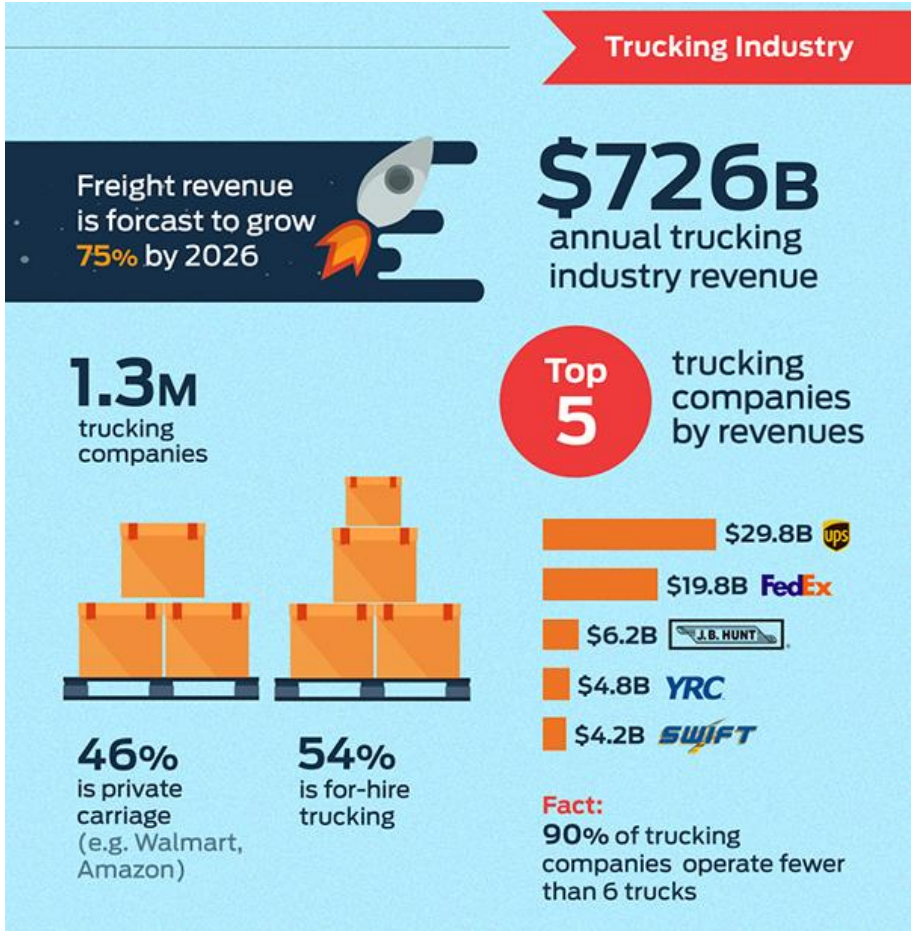
Analysis of gasoline needed for equivalent tax, and ICE mileage for this much gasoline (at 35 mpg)

Source: http://www.sierraclub.org/compass/2017/02/flurry-state-bills-introduced-likely-backed-oil-industry-penalize-electric-car

freight movement

Truckerpath: Trucking industry is a key component of U.S. economy; driver most common job in 29 states

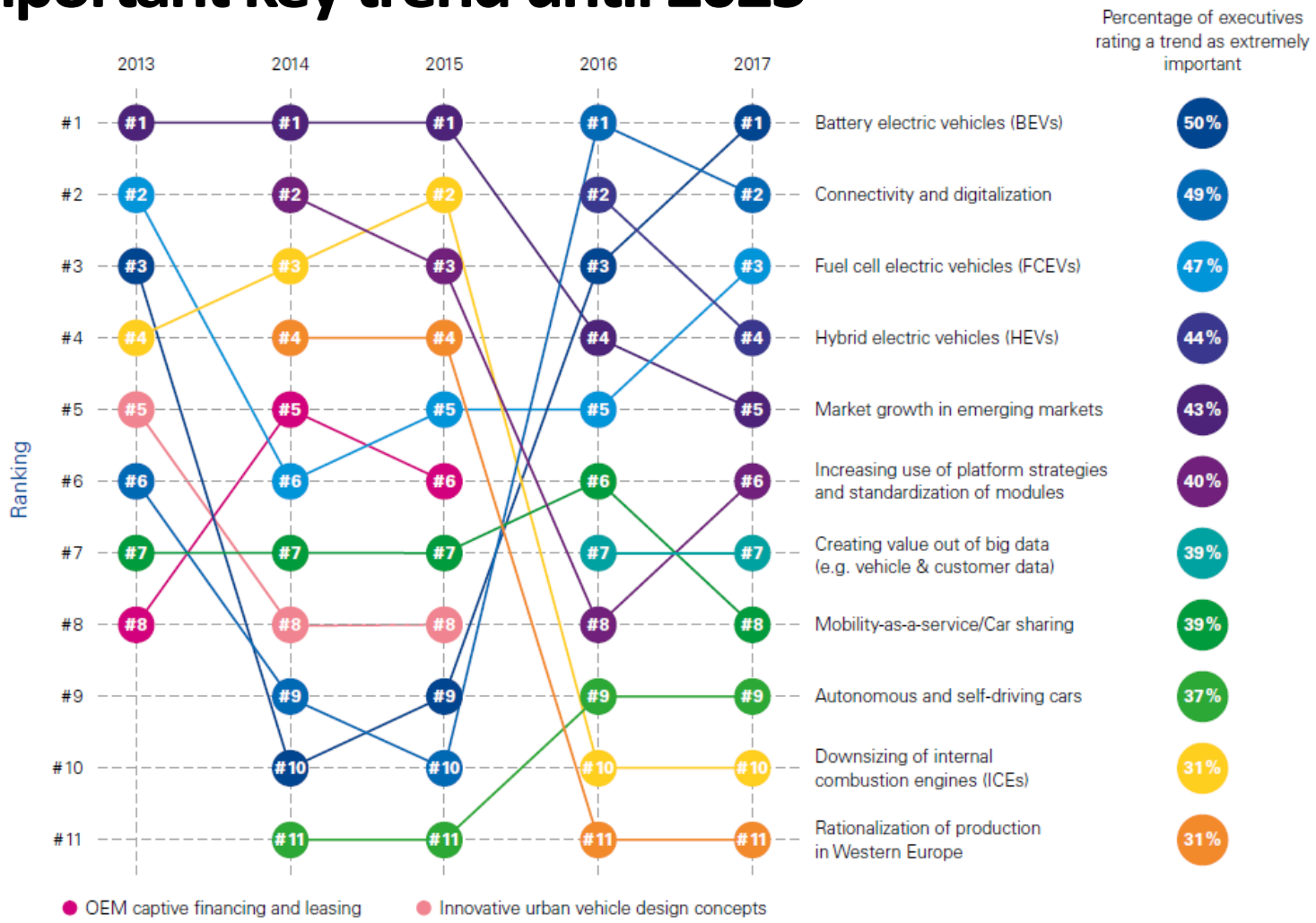




Source: https://truckerpath.com/blog/truck-freight-in-america-infographic/

executive perspectives

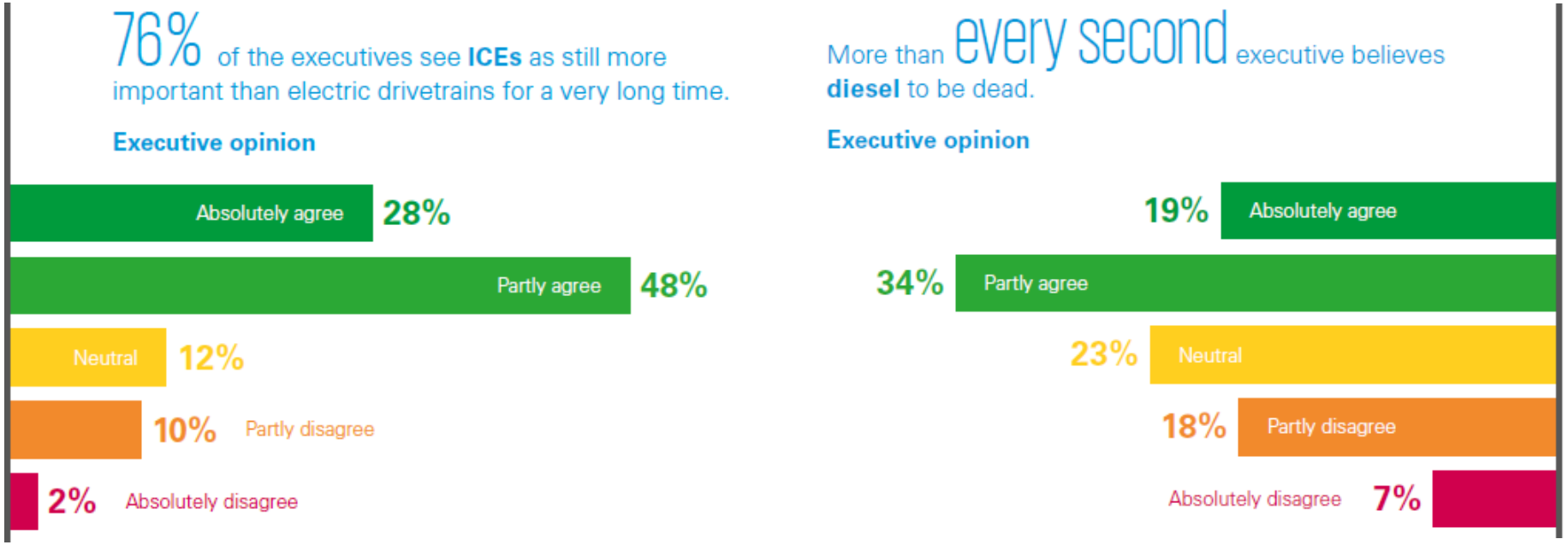
KPMG: Auto executives view electrification as most important key trend until 2025



Source: https://home.kpmg.com/xx/en/home/insights/2017/01/global-automotive-executive-survey-2017.html

executive perspectives

KPMG: Auto executives view ICE as more important than electric drivetrains and diesel as dead



Source: https://home.kpmg.com/xx/en/home/insights/2017/01/global-automotive-executive-survey-2017.html

summary observations

energy U.S. top petroleum producer in the world; transportation energy usage projected to peak in 2018

automotive LDV sales set record high again in 2016, 1/3 of LDVs are SUVs; China top EV market in the world

tech/enviro Fuel economy at all-time high; automakers are filing more patents than before; CO_2 emissions decreasing in U.S. and worldwide; transportation emissions comparable to electric

opinion/policy VMT at all time high; EPA GHG standards may lead to short-term job losses and long-term gains; auto executives view EVs as most important coming trend

17.1
1Q 2017

qar
summary